MECHANICAL ENGINEERING

September 1960

True Amplification of Light

An assignment in migrating ions . . . for Lukens Application Research.

Corrosion. This is the metallurgical result of ion migration. It's a frequent opponent for the Lukens Application Engineer in his job of helping you determine the *best* steel for "problem" applications. In the case of miscellaneous-cargo tankers, for instance, corrosive hot caustics are often carried on one leg of a trip; on another... high purity glycerine that must not become contaminated. How, marine designers asked, can we get *economical* protection both for cargoes and hold tanks? Drawing on years of experience with process industries equipment, Lukens Application Research suggested the answer: nickel-clad steel—highly corrosion-resistant, comparatively inexpensive—with a special sodium hydride finish that is easy to clean, expedites conversion.

Experience and ingenuity are the stock-in-trade of Lukens Application Engineers. For personal assistance on problems of metals application—corrosion, cryogenics, metal expansivity, abrasion, structural stress please contact us. Write Manager Application Engineering, G-90 Services Building, Lukens Steel Company, Coatesville Pennsylvania. Also contact us for Clad Steel Equipment Bulletin No. G-90.

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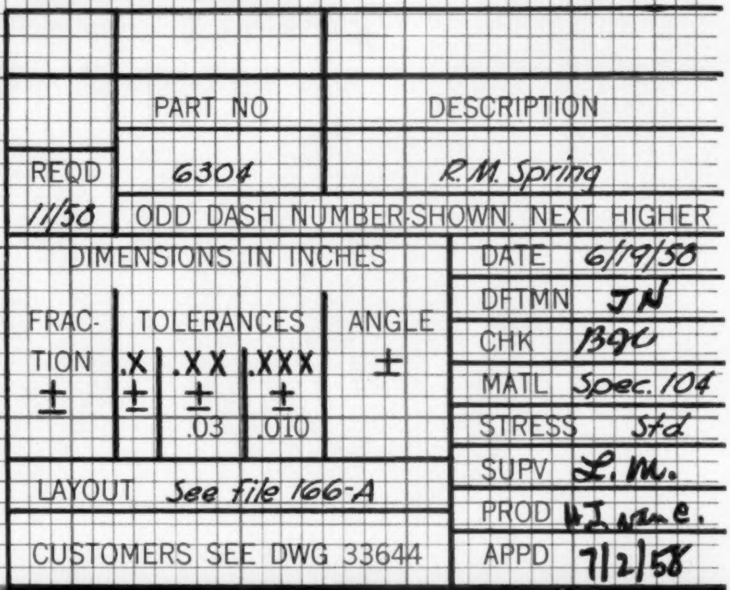

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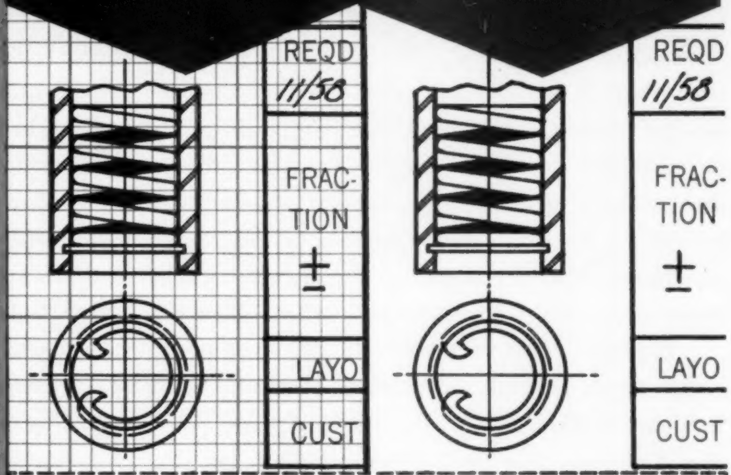

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MECHANICAL ENGINEERING

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MECHANICAL ENGINEERS

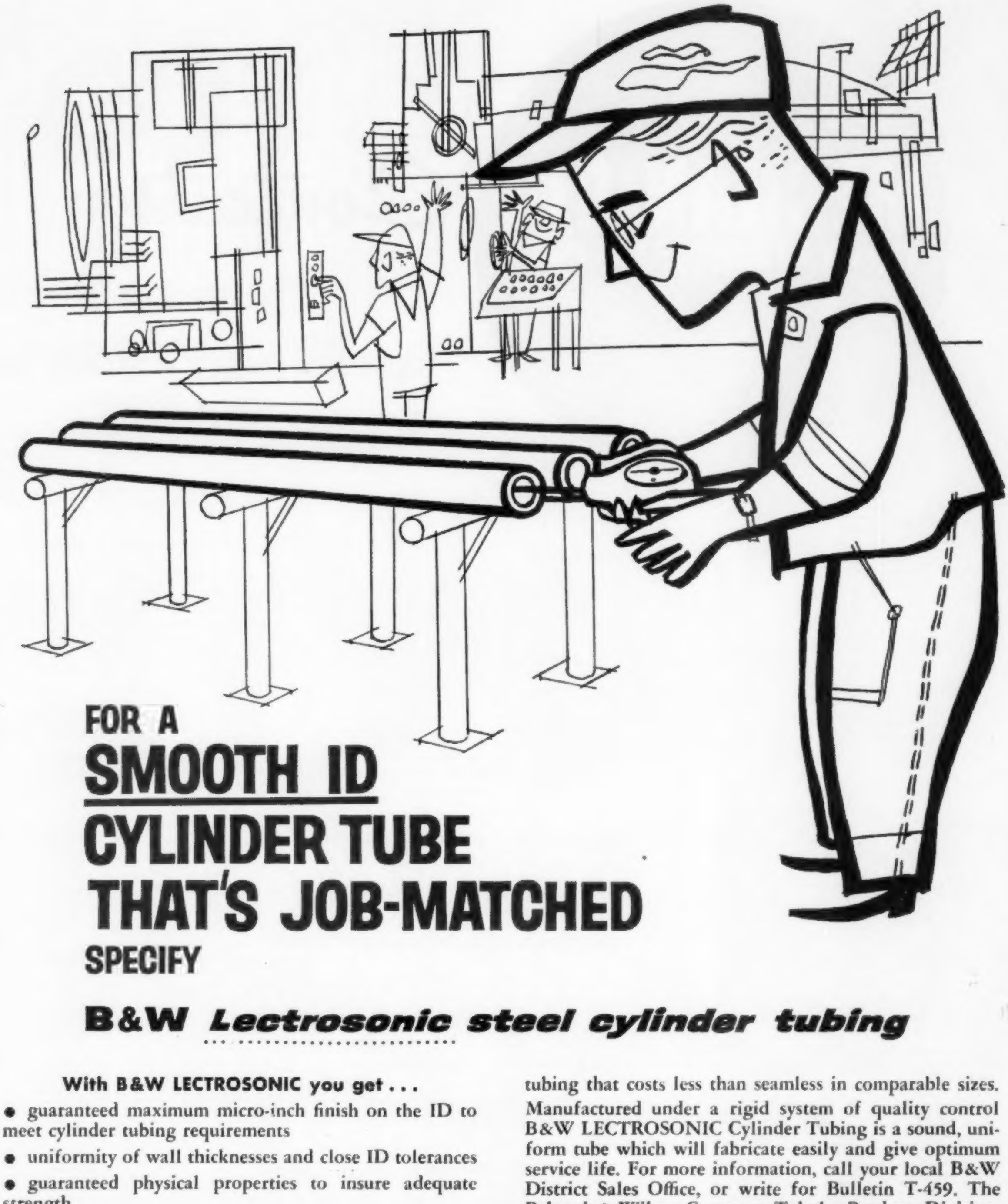
Contents

VOLUME 82 • NUMBER 9 • SEPTEMBER, 1960

THE COVER

At Hughes Aircraft they have created a source of "coherent light." The picture shows Dr. Theodore H. Maiman, senior staff physicist, with the "laser" (light amplification by stimulated emission of radiation), also called an "optical maser" (microwave amplification, etc.). At the center of the flash-tube lamp is a rod of synthetic ruby crystal. Bombarded by random light, the gem radiates light waves of almost a single frequency, its coherent properties similar to those of radio waves. See Briefing the Record, pp. 75–76.

Contents continued on following page



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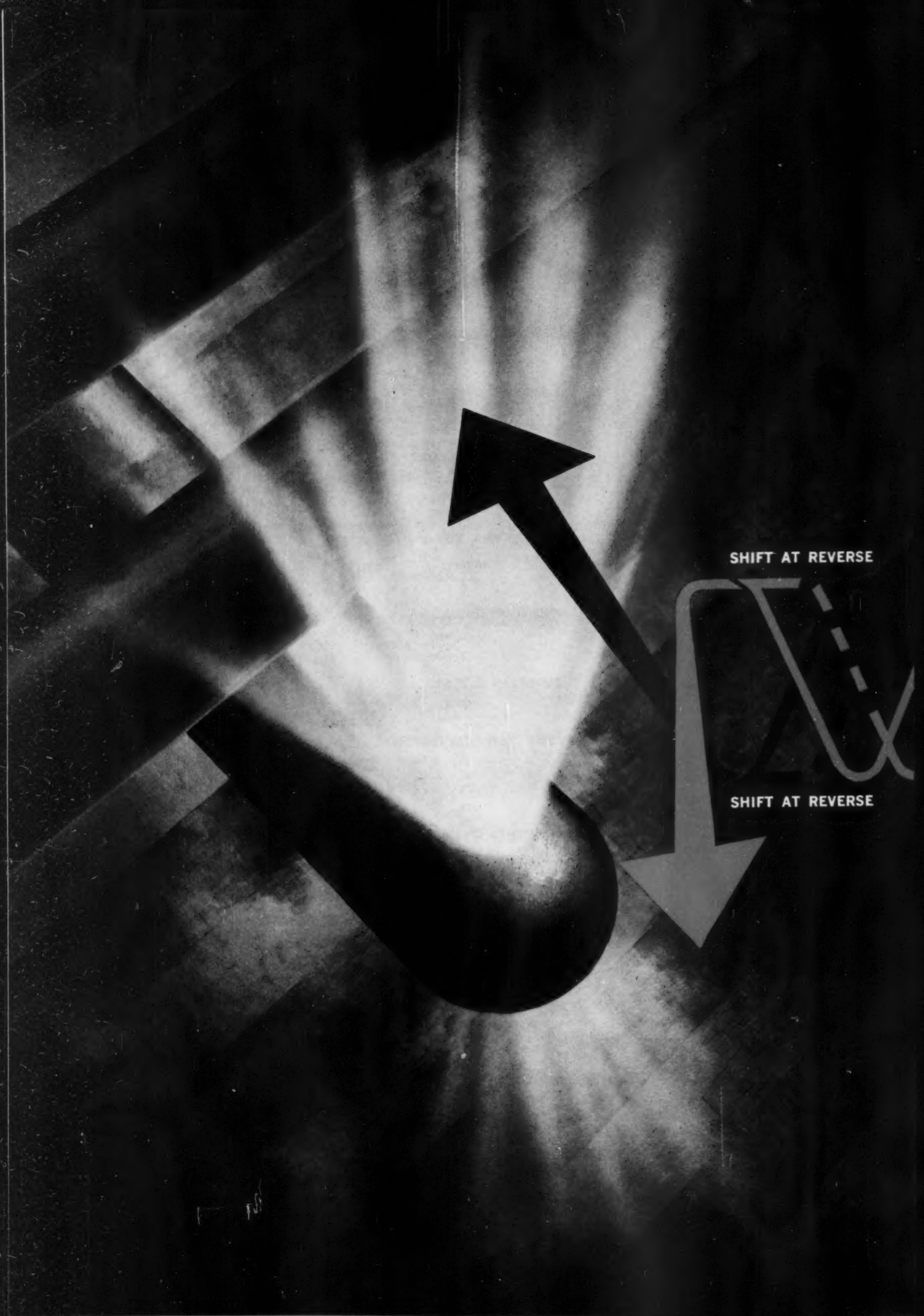
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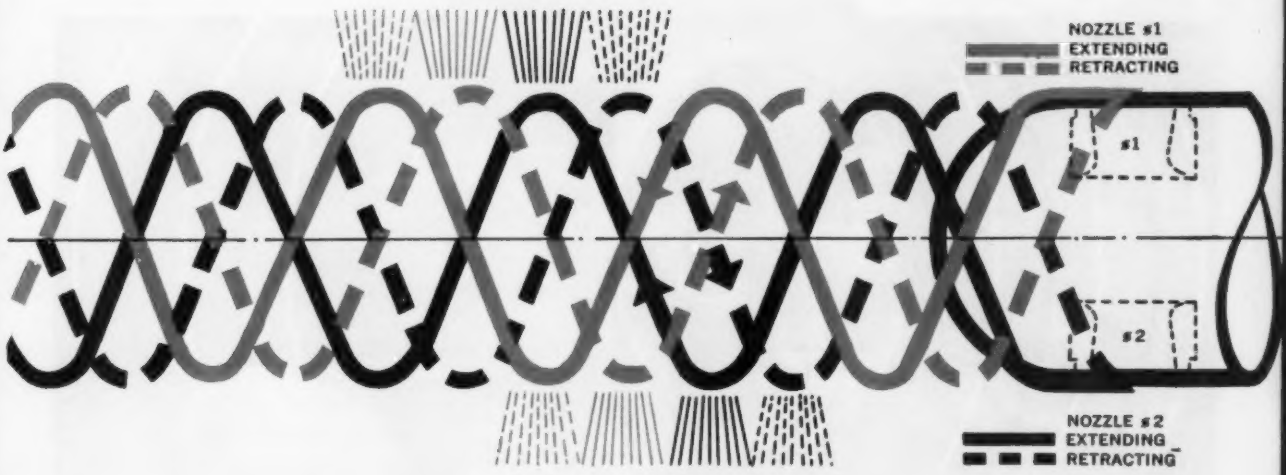

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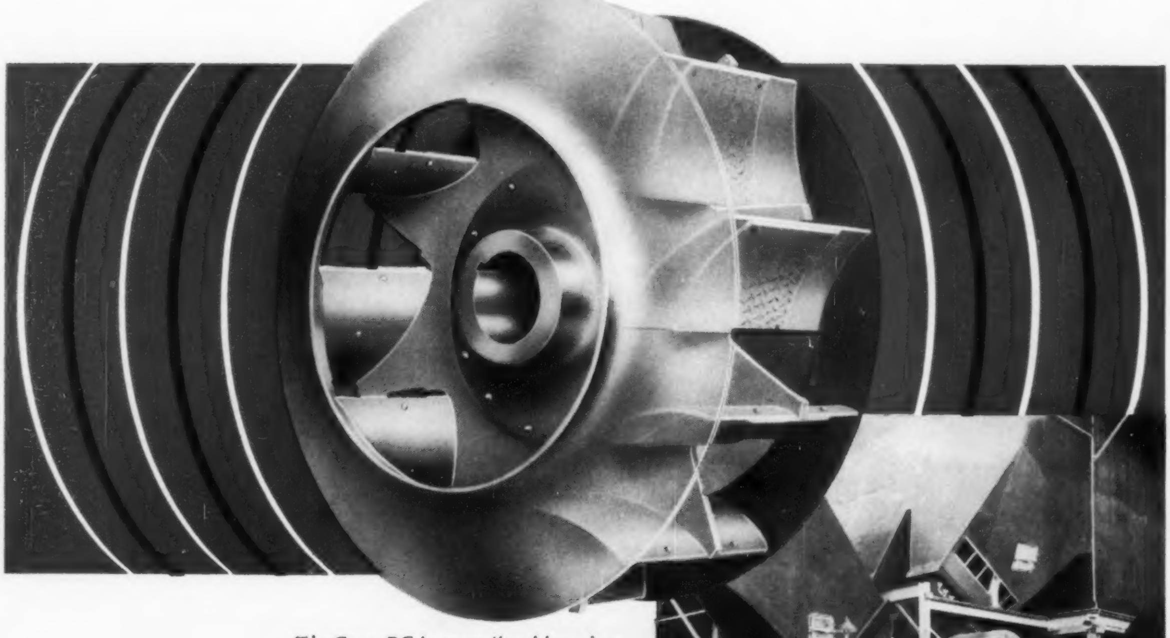
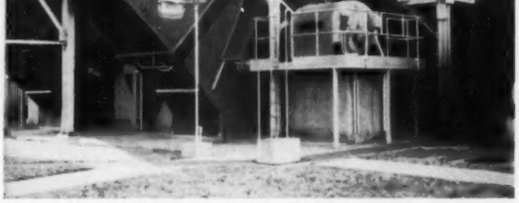


The Green RG is a centrifugal fan whose blades are forward curved and backwardly inclined with blade tips approaching a radius of the wheel. Design achieves a streamlined air passage with a minimum of turbulence.



This is the induced draft Green RG Fan installation at the Possum Point Power Station. 1/4" housing and inlet boxes. 1/2" scroll liners. Diamond checkered floor plate blade liners. Air-cooled, self-aligning sleeve bearings. 600 HP, 880 RPM motors.

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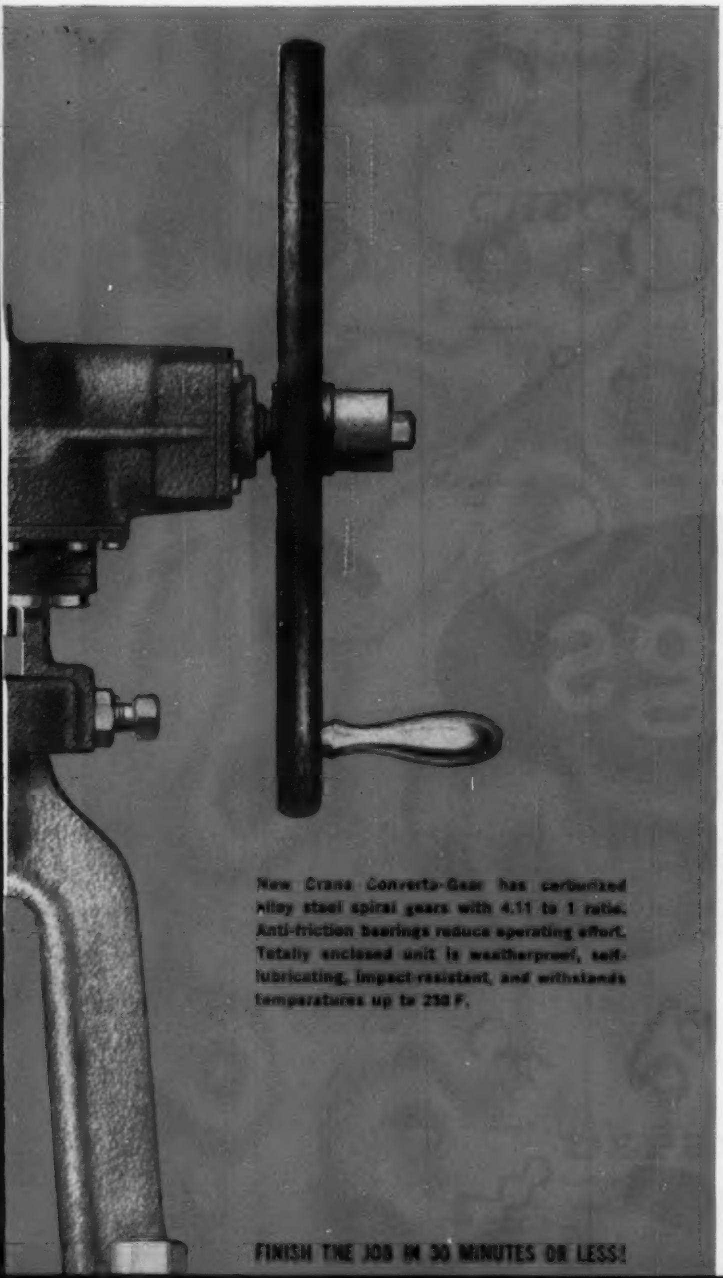

New Crane Converto-Gear has carburized alloy steel spiral gears with 4.11 to 1 ratio. Anti-friction bearings reduce operating effort. Totally enclosed unit is weatherproof, self-lubricating, impact-resistant, and withstands temperatures up to 250 F.

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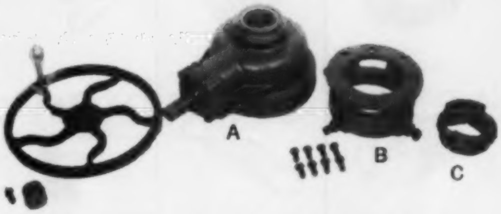

Only three parts needed to convert your OS & Y valve to gear operation: (a) Crane Converto-Gear Operator, (b) adapter for mounting operator on valve, (c) yoke sleeve adapter. Handwheel and mounting bolts furnished with conversion kit.

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Your Crane Distributor can give you complete information on this brand-new idea in gear operators for gate valves. The Converto-Gear is standard and universal, readily mounted on Crane iron and steel gate valves in sizes from 6-inch to 36-inch, in outside screw and yoke or non-rising stem patterns.

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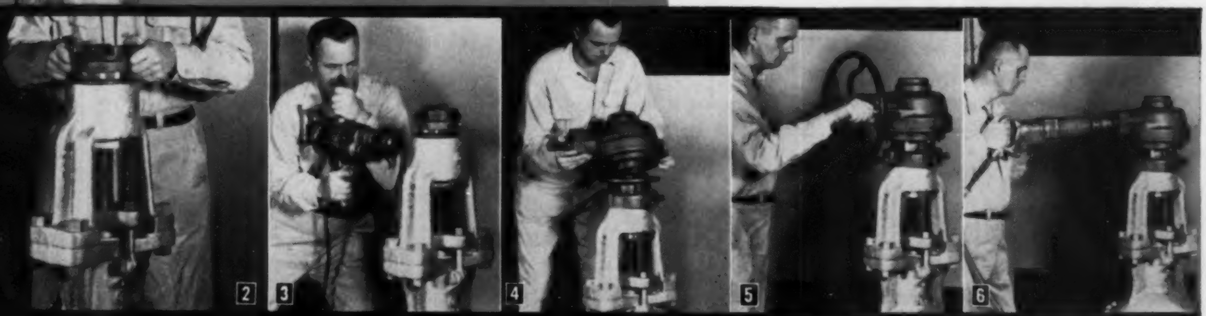

To convert your OS & Y valve, (1) remove the handwheel, (2) mount the yoke sleeve adapter, (3) countersink 4 holes for the Converto-Gear adapter, (4) bolt the adapter in place and attach your Crane Converto-Gear Operator, (5) and you're ready for smooth, manual operation, (6) or fast operation with an air or electric power operator.

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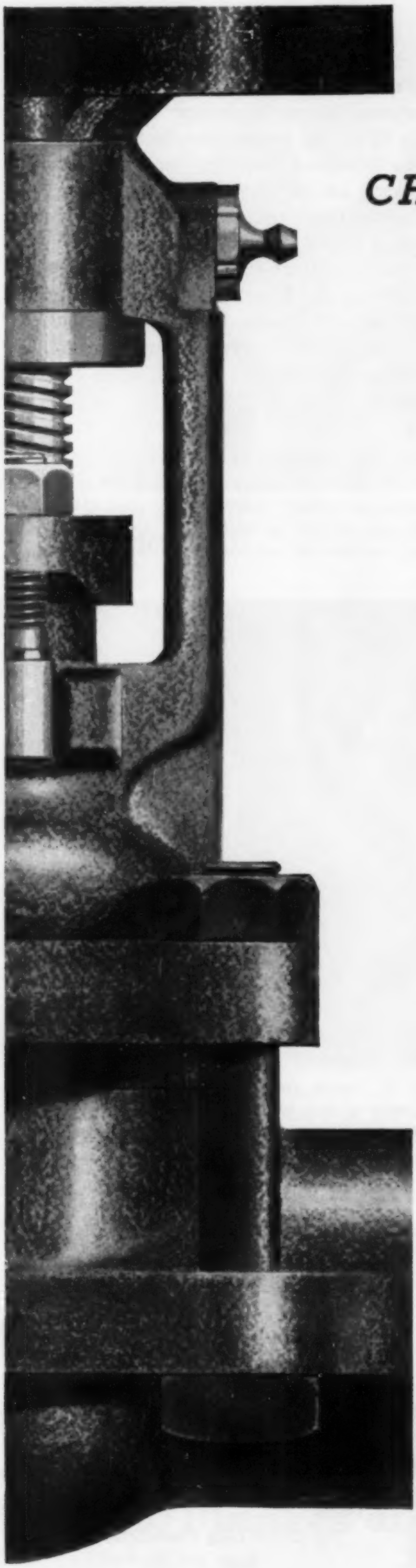

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The LimiTorque Motorized Valve Operators shown above are mounted on 10" Chapman Gate Valves, operating on boiler feed water line at 3600 p.s.i. . . . one of which is equipped with D.C. motors for emergency operation. Many LimiTorque Operators are used in this modern plant for the operation of valves on various steam and water lines . . . thousands of LimiTorque Operators are in constant use in Power Plants throughout the World.

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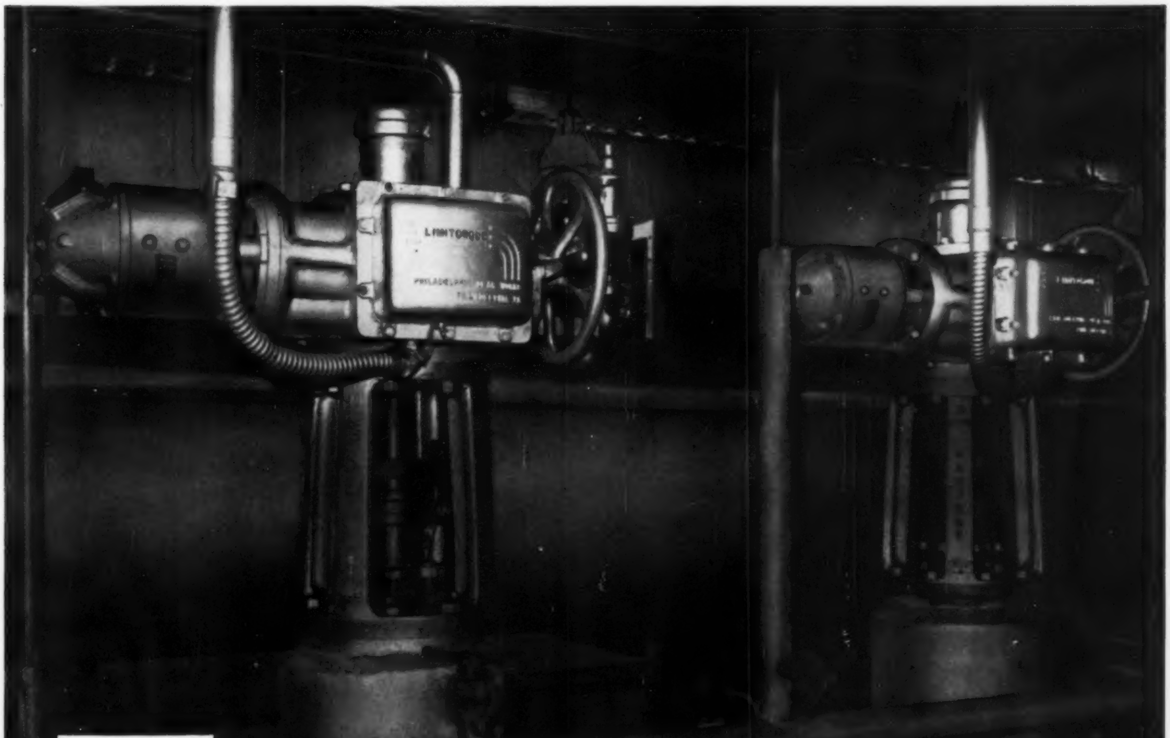

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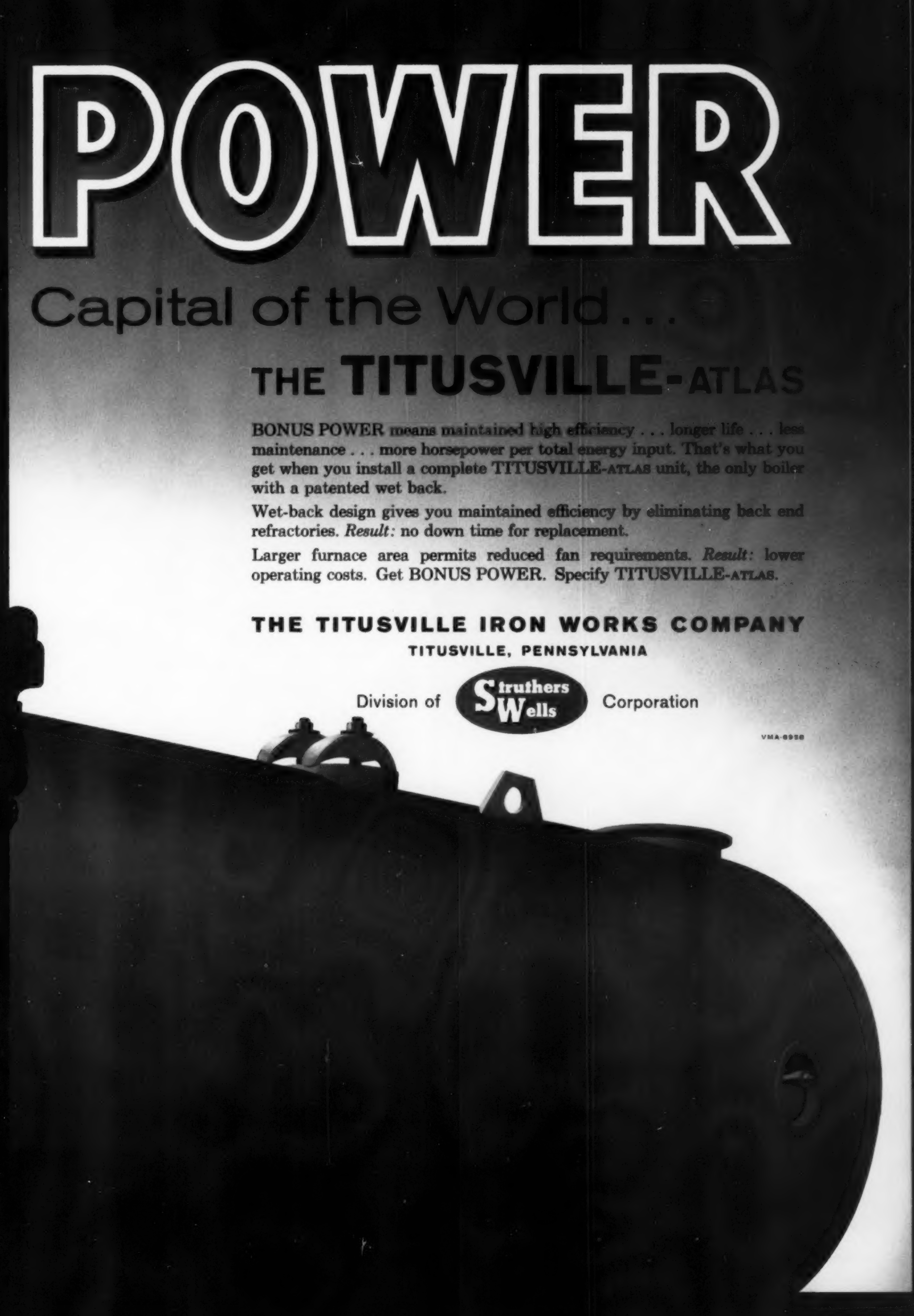
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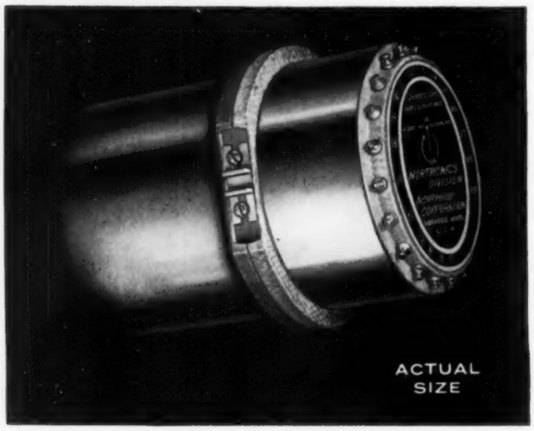

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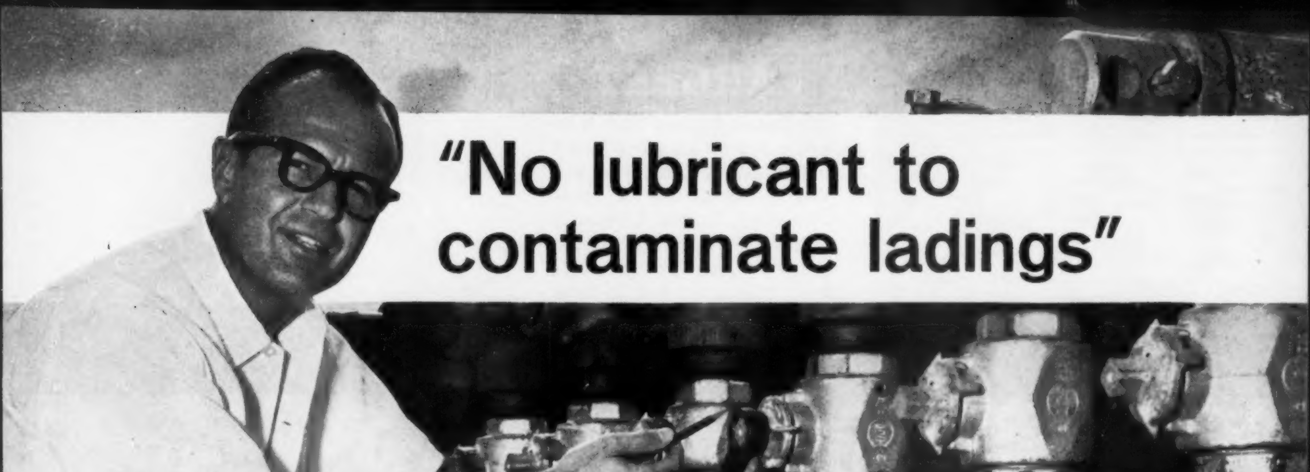

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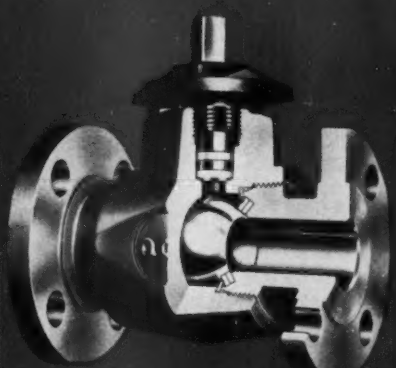

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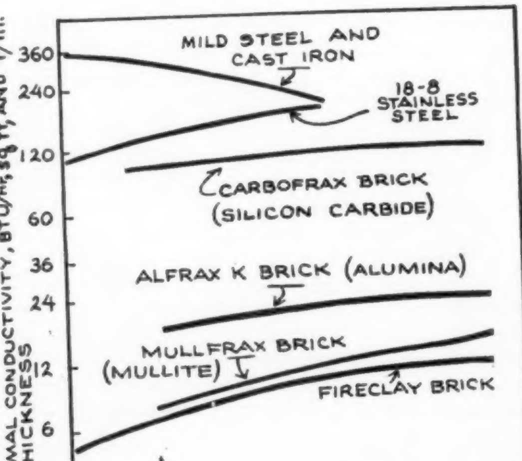
The chart at left shows thermal conductivity of various Carborundum refractories—including silicon carbide, alumina, and mullite—as opposed to metals and fireclay brick. For the refractory best suited to your particular application, feel free to call on Carborundum's accumulated experience.

Comparison of heat conductivity shows that water boils turbulently on CARBOFRAX® silicon carbide brick; barely gets tepid on fireclay. Heat conductivity of CARBOFRAX brick is roughly 11 times that of fireclay and about 70% that of chrome-nickel steel. Thermal conductivity of CARBOFRAX brick is 109/Btu hr., sq. ft. and °F/in. of thickness.



Coefficients of thermal conductivity for some of Carborundum's refractories and other materials at different mean temperatures. Information adapted from Figure 4, Carborundum "Refractories" Vol. 3, No. 5, December 1958. This bulletin, containing extensive technical information on the properties and applications of refractory-type products, is published bi-monthly. A request will put you on the mailing list.

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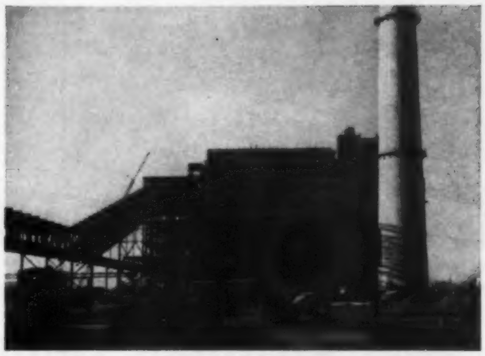

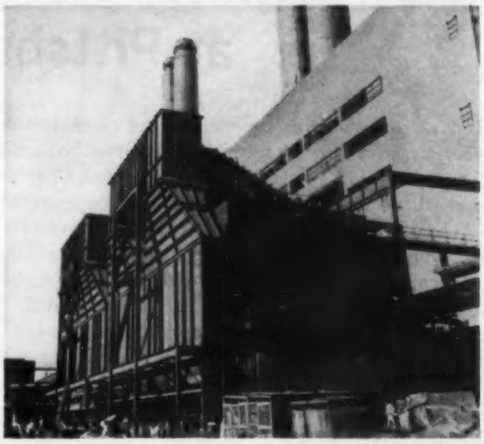

** In addition to the Cottrell installations shown, Research-Cottrell has also completed or begun three more large 99% fly ash installations rated at 3,360,000 total cubic feet per minute. Two of these are repeat orders based on the excellent performance of those in service.*

Yes—99% is a rigid requirement. And it obviously requires the *best* in Cottrell precipitation equipment.

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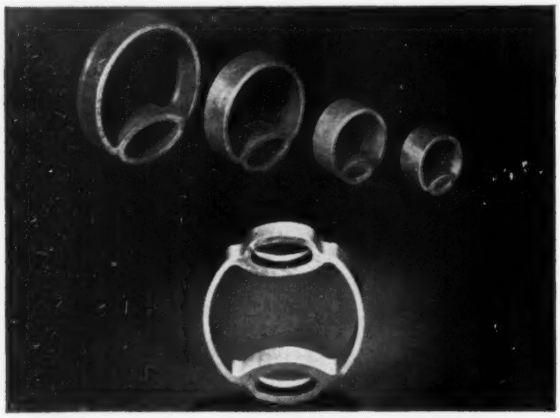
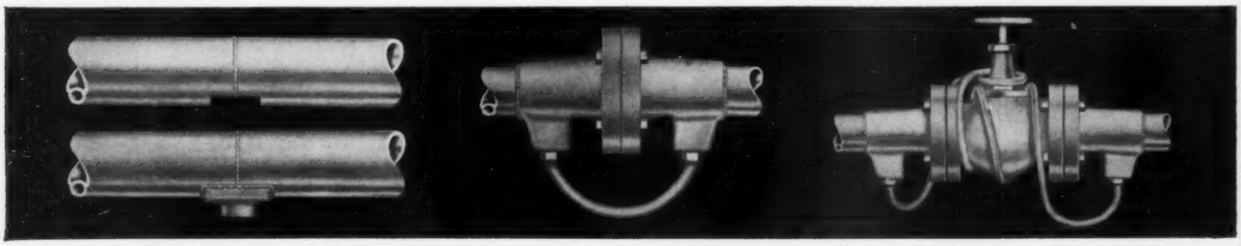
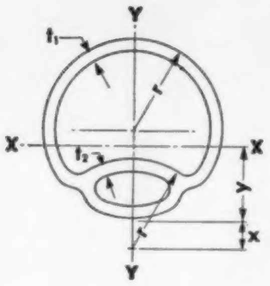


The development of DUOTRACE has opened broad new areas of design exploration in the field of heat transfer. By adding a second trace chamber to the one previously available in UNITRACE, DUOTRACE permits recirculation of the trace fluid. This opens up a whole new area of heat transfer design. Not the least of the possibilities is this: certain types of heat exchangers may now be extruded as single units. The cost savings implicit in such a unit are almost staggering. Alcoa engineers will be happy to assist you in exploring such design innovations in your own plant or process.

Fittings and connections for UNITRACE and DUOTRACE: Unflanged connections can be made easily and effectively with the special UNITRACE Trace Cap. As illustrated, trace chambers in adjoining sections are cut back and a circumferential weld is made to seal the product chamber. The cut back trace section is then covered with a UNITRACE Trace Cap welded in place with 4043 weld wire. Simple, efficient **flanged connections** utilize special UNITRACE flanges designed to accommodate both trace and product chambers. Jumper connections are used to carry the trace across the connection, and special impingement plates in the flange shield the product chamber from erosion as steam passes through the flange. **Valves, pumps and other fittings** can be incorporated into the traced systems by using UNITRACE flanges which mate with all 150-lb ASA flanges, valves and pumps. UNITRACE and DUOTRACE systems accommodate standard preformed pipe insulation.

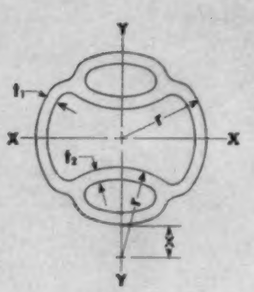


UNFLANGED CONNECTIONS — FLANGED CONNECTIONS — VALVES AND FITTINGS



	Unitrace Sizes	1 in.	1½ in.	2 in.	3 in.	4 in.	6 in.	8 in.
Axis XX	Moment of Inertia (I) in.^{4}	.09	.34	.72	2.71	6.52	31.82	81.82
	Radius of Gyration (R) in.	.37	.58	.72	1.09	1.42	2.12	2.78
	Section Modulus (S) in.^{3}	.13	.34	.56	1.42	2.65	8.73	17.22
Axis YY	Moment of Inertia (I) in.^{4}	.09	.33	.70	2.65	6.36	29.72	76.70
	Radius of Gyration (R) in.	.37	.57	.71	1.08	1.40	2.05	2.69
	Section Modulus (S) in.^{3}	.14	.34	.59	1.52	2.83	8.97	17.79

Sizes	1 in.	1½ in.	2 in.	3 in.	4 in.	6 in.	8 in.
r	.657	.950	1.187	1.750	2.250	3.312	4.312
t_1	.133	.145	.154	.170	.187	.280	.322
t_2	.145	.163	.174	.185	.200	.307	.354
x	.133	.344	.406	.625	.813	1.500	2.000
y	.61	.87	1.08	1.59	2.03	2.98	3.87



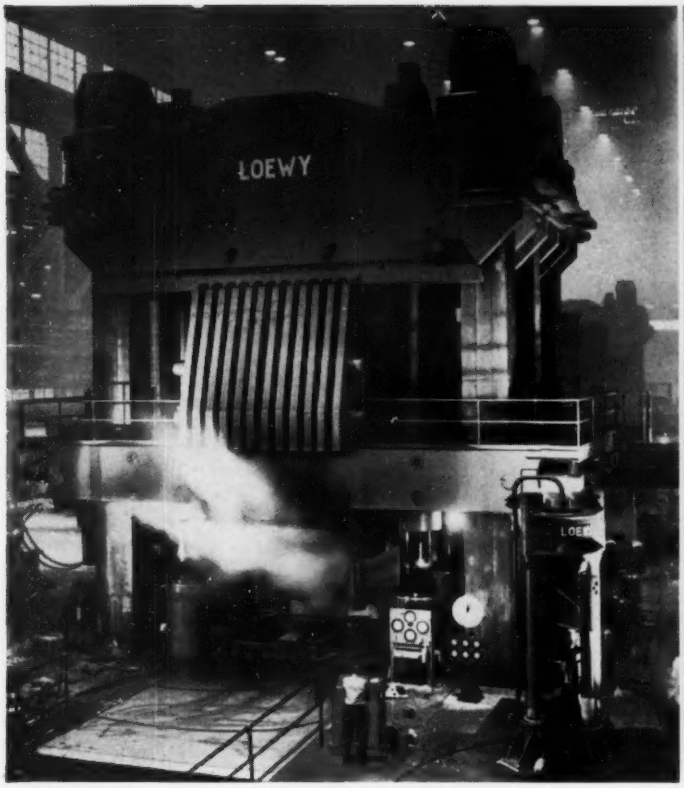
	Duotrace Sizes	1 in.	1½ in.	2 in.	3 in.	4 in.	6 in.	8 in.
Axis XX	Moment of Inertia (I) in.^{4}	—	—	.80	3.06	7.53	—	—
	Radius of Gyration (R) in.	—	—	.74	1.12	1.46	—	—
	Section Modulus (S) in.^{3}	—	—	.68	1.75	3.35	—	—
Axis YY	Moment of Inertia (I) in.^{4}	—	—	.67	2.59	6.29	—	—
	Radius of Gyration (R) in.	—	—	.68	1.03	1.33	—	—
	Section Modulus (S) in.^{3}	—	—	.57	1.48	2.80	—	—

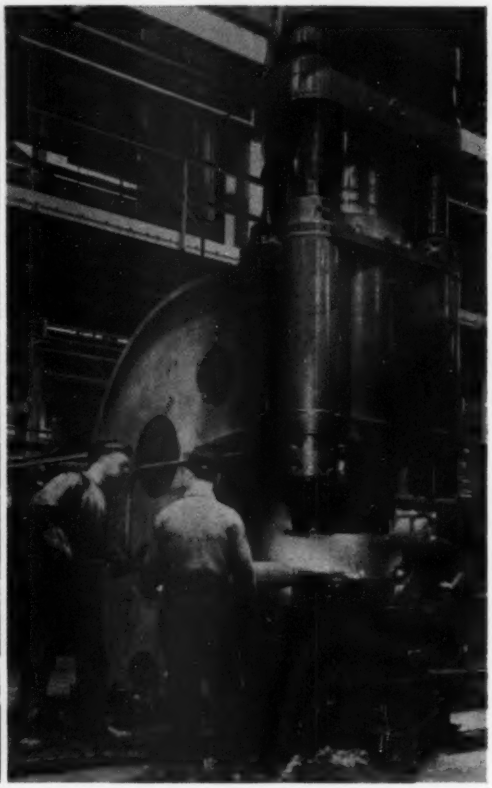
Sizes	1 in.	1½ in.	2 in.	3 in.	4 in.	6 in.	8 in.
r	—	—	1.187	1.750	2.250	—	—
t_1	—	—	.154	.170	.187	—	—
t_2	—	—	.174	.185	.200	—	—
x	—	—	.531	.843	1.125	—	—
y	—	—	—	—	—	—	—

Unitrace-Duotrace Sizes	1 in.	1½ in.	2 in.		3 in.		4 in.		6 in.	8 in.
Product Area (in.^{2})	.64	1.68	2.72	2.36	6.38	5.67	10.84	9.74	24.64	42.79
Trace Area (in.^{2} each)	.10	.16	.35	.22	.98	.61	1.86	1.07	2.85	5.12
Metal Area (in.^{2})	.65	1.03	1.39	1.46	2.28	2.46	3.24	3.53	7.05	10.60
Weight (lb/ft)	.77	1.22	1.66	1.72	2.71	2.89	3.85	4.16	8.38	12.60
*Min. Bend Radii (in.)	5	8	10½	10½	17	17	24	24	36	48
Wetted Perimeter (in.)										
Product	3.35	4.92	6.31	6.28	9.68	9.65	12.72	13.02	18.63	24.75
Trace (each)	1.49	1.71	2.40	1.87	4.13	3.22	5.32	4.23	6.75	9.63
Fitting Weights (lb)										
Trace-Caps	.102	.126	.240	.13	.464	.40	.674	.55	1.67	2.92
Elbows	.706	1.347	2.111	2.65	5.244	6.59	9.649	11.68	27.76	52.51
Impingement Plates	.024	.039	.057		.101		.162		.22	.34
Stub Ends				.65		1.50		2.13		
Terminal Casting				.50		1.12		1.75		

	1–2 in.	1½–2½ in.	2–3 in.	3–4 in.	4–6 in.	6–8 in.
Adapter Flanges	2.419	3.816	4.774	7.216	11.106	19.23

(Note: UNITRACE values are indicated in clear areas in the table above. DUOTRACE values are shown in the shaded areas.)
*Unitrace may be bent in any direction to these radii provided reasonable tooling is employed.





These two Loewy presses graphically illustrate B-L-H's ability to meet your forging press needs, regardless of press size.

WHAT DO THE CRITICS HAVE TO SAY ABOUT B-L-H LOEWY FORGING PRESSES?

We're talking about the severest, most discriminating critics we know—our customers. With a substantial capital investment involved, they unhesitatingly demand that Loewy presses perform superbly.

Here are just two examples of our customers' judgments. A leading alloy steel manufacturer in Pennsylvania spotlights our 2000-ton forging press in his full-page advertisement in national magazines. The copy states that the Loewy press improves the production of his quality tool steels and that it is "... speeding delivery of more-uniform large forgings" in regular production and is "... ready to meet special custom forging demands."

Another well-known steelmaker stimulates his sales by means of two brochures which focus on his Loewy press. He testifies that "this fast-acting 2000-ton hydraulic forging press imparts to special steels internal qualities never before achieved."

Similar statements about our equipment are made very frequently. Certainly one of the most remarkable is in a report to the U.S. Air Force which foresees savings of approximately $13,000,000 on a single model of a jet fighter, thanks to the economical production of parts on the famous 50,000-ton Loewy forging press.

B-L-H builds presses for free forging, open die forging, and closed die forging, for hot and cold working of all kinds of metals—ferrous and nonferrous, rare, nuclear and exotic. These machines are available in all capacities from *five hundred to fifty thousand* tons or more. Write Dept. F-9 for further information.

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Here's <u>How</u> KENNEDY'S Union Bonnet and Cylindrical Body Simplify Installation and Increase Valve Life...

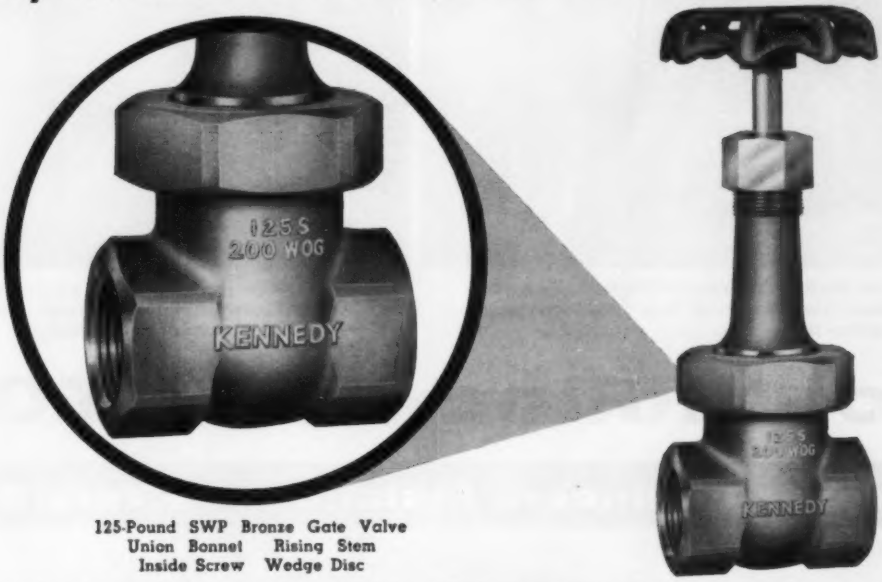
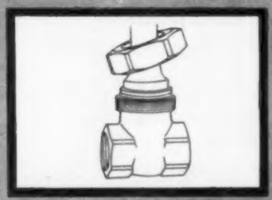
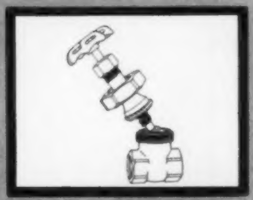


Fig. 525

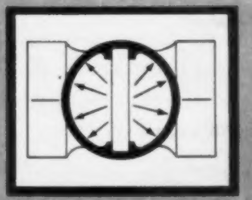
125-Pound SWP Bronze Gate Valve
Union Bonnet Rising Stem
Inside Screw Wedge Disc



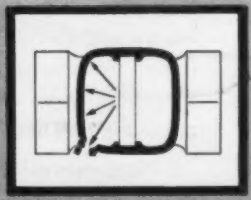
Kennedy's Union Bonnet permits repeated dismantling for cleaning or inspection and reassembly without danger of distortion of the valve. The bronze-to-bronze construction makes a tight union for tight, leakproof operation.



Kennedy's Fig. 525 can be easily disassembled into component parts for installation in otherwise inaccessable places in existing lines or for new installations.



Kennedy's cylindrical body construction when under severe pressure resists rupture and minimizes deflection thus preventing leakage at the seat.



Pressure in ordinary non-cylindrical valve bodies tries to push the body wall out to form a circle or cylinder. Rupturing stresses concentrate where wall has the shortest radius. Resultant deflection causes leakage over disc and early failure.

These <u>additional</u> advantages make KENNEDY your best valve buy ...

Rugged, wider hex ends, blended into body, prevent distortion. On a conventional valve body, hex ends protrude from the body and are connected by thin body wrists. This area under severe wrench pressure, can distort and cause disc seating trouble. Kennedy's wider hex ends are blended into the body making the body and hexes one unit. In this way wrench pressure can be absorbed.

Newest in the valve field . . . best in the valve field . . . Fig. 525 gives greater strength with less bulk and weight than any comparably rated valve.

Kennedy's Fig. 525 can be repacked under pressure, eliminating line shut-downs. You simply open valve fully, remove packing nut and then repack.

• *YOU CAN'T BUY A BETTER VALVE THAN A KENNEDY!*

KENNEDY VALVE MFG. CO.

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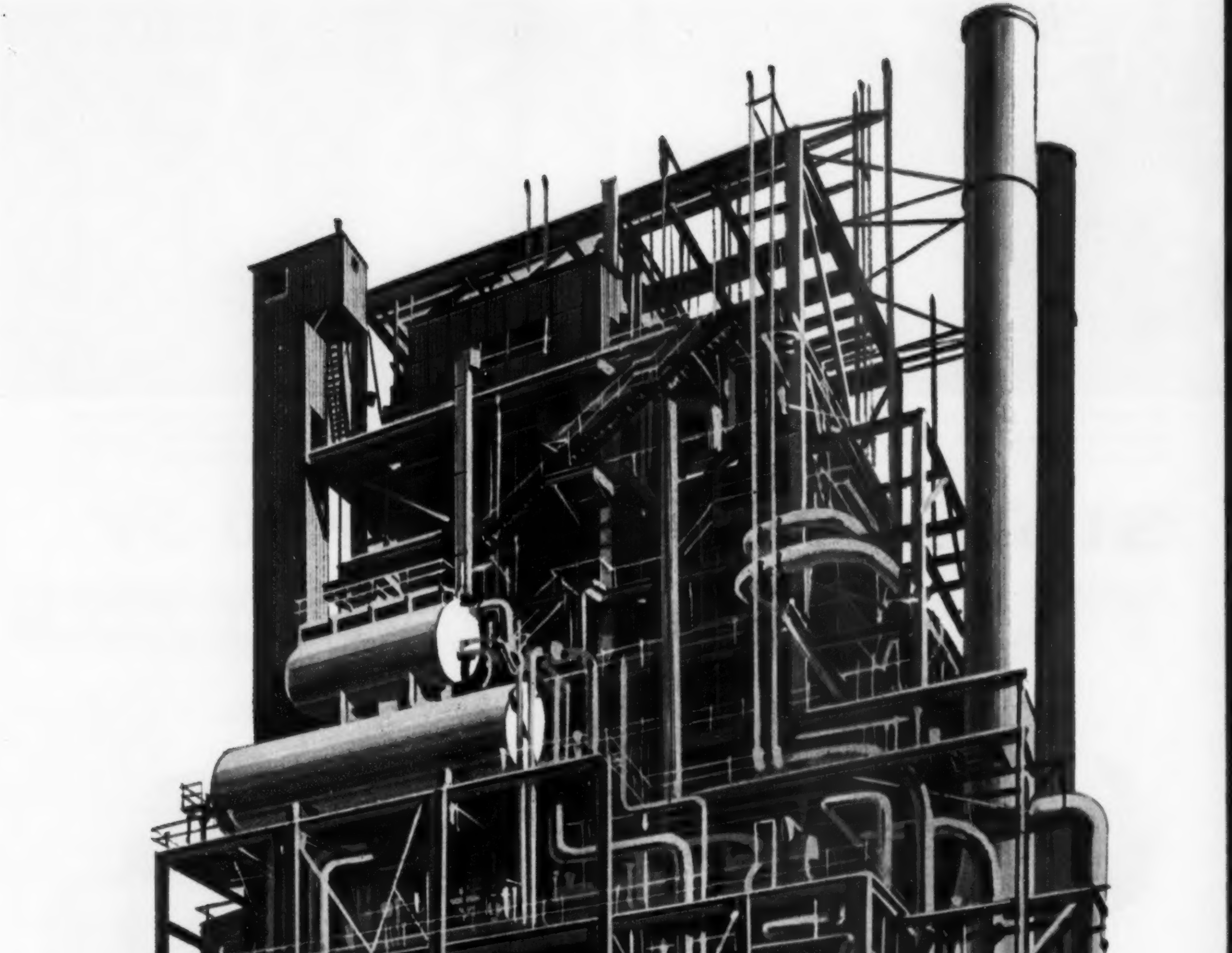
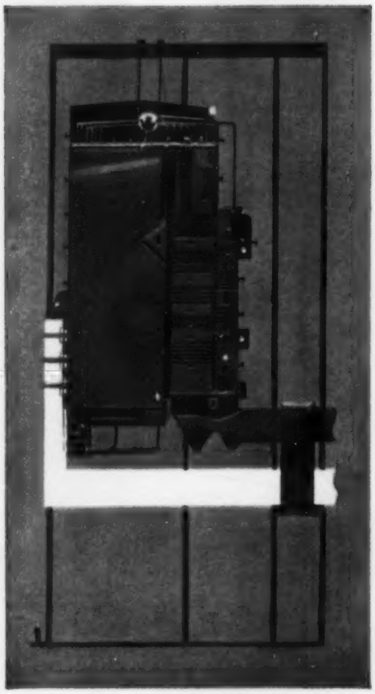




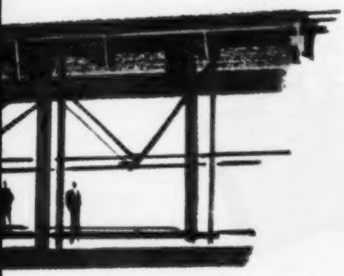
A word about steam generators

In this age of miracles some forthright words have been mislaid.

One is *thoroughness.*

Thoroughness is as much a product of our company as steam generators. By *thoroughness* we mean "careful attention to detail"—not some of the time but all of the time.

What does this mean to you? It means you save money on operations, keep your maintenance staff to a safe minimum, and prevent costly power interruptions.



Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, N.Y.

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NEW YORK LONDON PARIS ST. CATHARINES, ONT.

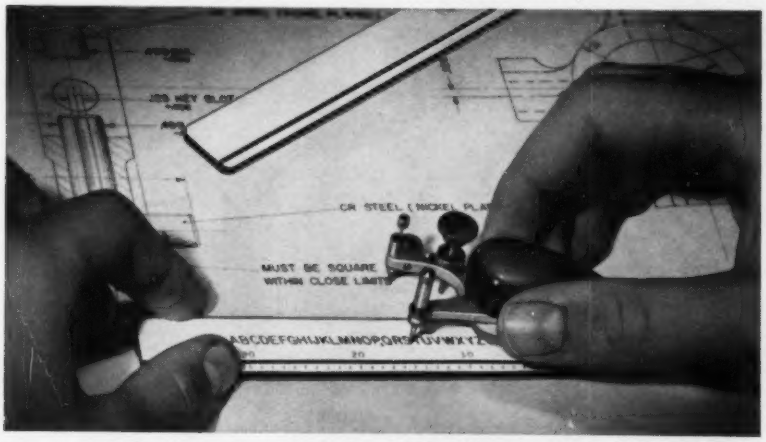
Some Ideas

for your file of practical information on drafting and reproduction . . . from **KEUFFEL & ESSER CO.**

When it comes to lettering — plain or fancy — professionals the world over turn to LEROY® Equipment by K&E. In drafting rooms, art departments — not to mention schools, business offices, churches, clubs, hospitals — LEROY has become almost as necessary as pencil and paper.

Truly, there's no magic about LEROY — just a beautifully simple idea, translated into products which reflect the highest manufacturing skill and imagination. Not easy, we grant you . . . but not magic.

However, to keep the LEROY line constantly up to the changing requirements of the times — that *does* require a wizard. Fortunately, we have just such a gentleman firmly settled on the K&E payroll. And he begs that we report several of the more recent minor miracles of LEROY right here and now. So, in the famed standard, sans-serif lettering template, let's make with a little . . .



abracadabra

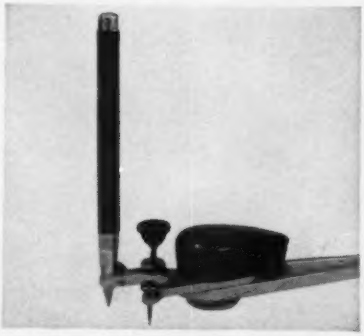
Templates

Every year sees new additions made to the already long list of LEROY templates. Case in point: the new electronic tube symbol templates for use in one of the most modern, fastest changing industries of them all. Also, there are foreign language templates (such as Russian and Greek), music templates, special designs, and a variety of handsome type faces (Caslon, Cartographic, Bernhardt Modern to name some newer additions).

The best advice we can give for keeping current on LEROY templates is to have the LEROY catalog on hand. (It just so happens that we recently put out a brand new edition of the catalog, and it's yours for the asking. See coupon at right.) Finally, of course, we should add that if you don't see what you need in our catalog, don't despair. We'll produce it, *custom-made*, to your design — as we have done for thousands of others.

A "Built-In" Pencil Point

The business of stopping work to put a sharp point on a lettering pencil is now largely over and done with, thanks to another new LEROY item. The point of the new LEROY "020" pencil never blunts or dulls — it's permanently sharp. And that, we submit, is a pretty sharp idea. The lead of this new pencil is an unvarying .020 inches in diameter, from one end to the other. All that's necessary to repoint is to advance the lead with a turn of the pencil



shaft. No need to remove it from the scriber, by the way. This new pencil fits all LEROY scribers, and guarantees faster, smoother work. As to appearance — all lines drawn with the "020" are perfectly uniform, and of exactly the same density (a careful balance, chosen to give good wear without sacrificing print-making quality). You never saw pencil work look so good.

The Pen With A "Built-In" Inkwell

Here's your ticket to faster ink work with far fewer refills—K&E's new LEROY Reservoir Pen. You'll be amazed at the mileage you can get between refills with this newly perfected pen. Its refillable cartridge holds enough ink for many hours of smooth, uninterrupted lettering, thus eliminating the need for daily cleaning. The pen's cartridge is airtight — made of a non-porous, unbreakable, translucent material. The level of ink is always visible, and any non-solvent, waterproof India drawing ink can be used (for best results and quicker, easier filling we recommend the LEROY Lettering Ink-Cartridge #2950).

A tiny weighted needle inside the pen's feed tube assures a clear passage of ink from reservoir to point. Light vertical shaking of the pen activates this needle, removing any particles which may have settled in the tube when the pen was set aside. The needle also provides efficient cleansing action when you wash out the pen.

LEROY Reservoir Pens are furnished in seven sizes, from 00 to 5, for use with all LEROY scribers. Ideal for lettering work, the points glide easily over paper, cloth or film based surfaces, producing sharp, uniform lines that reproduce crisply.

Order Your LEROY Catalog Now

Other new additions and improvements — too numerous to go into here — are described in the new LEROY catalog. The coupon below brings your copy, free.

KEUFFEL & ESSER CO., Dept. ME-9, Hoboken, N. J.

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Intense, white light — 70 times brighter than previous model (4.2 million candlepower on low-speed range).

Short-duration light flash (1 to 6 μsec) "freezes" motion . . . practically eliminates blur . . . lets you clearly see details that are invisible with other commercial stroboscopes.

Long-throw beam reaches into machine innards — made possible by basic new flash tube developed exclusively for this instrument.

Measures speeds directly with $\pm 1\%$ a
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In automotive laboratories, the new Strobotac's bright light and short-duration flash make possible detailed study of the formation of fuel-injection spray patterns. The Strobotac's sharp flash freezes the high-velocity droplets in the atomized spray, permitting study of droplet size and range.

(Photo courtesy Norton Comp

In industry, Strobotacs are
machine parts and to exan
tions. At NORTON COMPA
motive cam-shaft grinder. It
ble finish of the cam surface
operated above its rated sp
ferential velocity of the Alur
point below its rated speed.

At GENERAL ELECTRIC's Small Aircraft Engine Department, the Strobotac helps engineers examine vibratory modes in aircraft gas turbine blades. In this work, the new Strobotac's short-duration white light greatly improves visual resolution. Mode shapes are clearly defined at various excitation frequencies produced by an electromagnetic driver.

(Photo courtesy General Electric Company)

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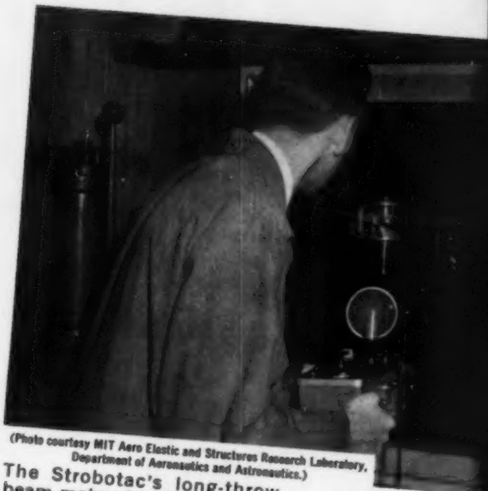
e widely used to check critical speeds of rotating mine performance under actual operating condi- ANY, the Strobotac checks operation of an auto- t is desirable to grind at high speed for best possi- es, yet for safety reasons the wheel should not be peed. Strobotac makes it possible to hold circum- ndum vitrified wheel to an exact, pre-established l.



(Photo courtesy MIT Aero Elastic and Structures Research Laboratory, Department of Aeronautics and Astronautics.)

The Strobotac's long-throw beam makes it possible to observe in detail a model helicopter rotor operating in a wind tunnel. Blade lag and flapping are clearly observed in slow-motion. This technique shows what is happening to the rotor under various flight conditions and at the same time serves as a visual check on vibration data provided by strain-gages mounted on the rotor head.

New Type 1531-A STROBOTAC®

ows Details You've Never Seen Before!

Range: 110 to 25,000 rpm in three direct reading ranges. Useful at speeds to 250,000 rpm.

Accuracy: ±1% of dial reading.

Intensity: New White Light — 4.2 million candlepower on low-speed range for easier viewing and improved contrast.

Light Pulse Duration: Approximately 1, 3, and 6 microseconds for the high, medium, and low-speed ranges, respectively.

External Input: Strobotac can be synchronized from an external contactor or a 6-volt peak-to-peak electrical signal.

Output Pulse: Available for triggering auxiliary equipment, using appropriate adapter.

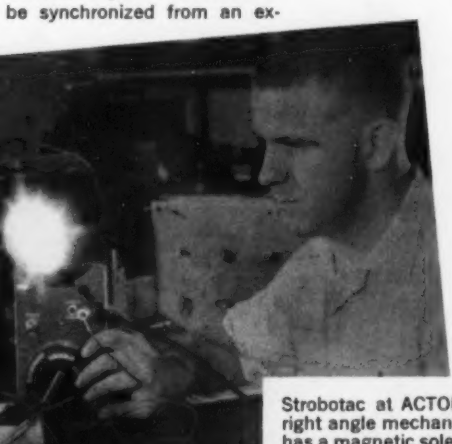
Power Input: 105-125 volts, 50 or 60 cycles. 35 watts, maximum.

Weight: 7⅛ pounds.

Price: . . . $260.

PIVOTING LAMP . . . can be rotated 360° in horizontal direction and 180° vertically. Lamp can now be aimed at object under investigation while instrument is held in most convenient position for clear, head-on view of calibrated rpm scale.

NEW CARRYING CASE . . . provides convenience in use . . . full enclosure for protection against damage. Has permanently attached cover and line cord which can't be lost . . . cover also doubles as convenient, adjustable stand.



Strobotac at ACTON LABORATORIES in a torque-measuring setup, tests right angle mechanical drives. A fractional hp motor powers the drive which has a magnetic solenoid clutch as its output load. The drive's output shaft is a gauge which indicates torque directly on a calibrated dial. Since the dial rotates with the shaft it must be "stopped" for torque readings. Strobotac's microsecond flash eliminates blur, permits reading as easily as though the fine dial calibrations were standing still, and allows Acton technicians to check a wide variety of dynamic conditions quickly and conveniently.

Printed in U

MECHANICAL ENGINEERING

VOLUME 82 • NUMBER 9 • SEPTEMBER, 1960

The First Five Years

By this time most of our young engineering graduates have embarked on their professional careers. And, according to Engineers' Council for Professional Development, "the next few years may well be the most challenging period of your life." One of ECPD's major objectives is to help guide young engineers on their way to maturity in the profession.

In describing the Council's plan for helping young engineers, W. L. Everitt, President of ECPD and Dean of Engineering of the University of Illinois, said that "too often there is a post-college slump in the careers of our young engineers."

"As an antidote for this probability, we are offering our First Five Years Program. It is designed to close the gap between college and the realities of earning a living," Dean Everitt explained.

The First Five Years Program is based on three cardinal principles:

1 Your employer, colleges, and engineering societies will provide you as a young engineer with *opportunity*, a favorable professional climate in which to grow.

2 Senior members of the profession will provide advice and *counseling* to assist you in making your plans and in evaluating your progress.

3 The final *responsibility* for professional advancement, however, rests squarely on your shoulders. Only you can make the best use of the First Five Years Program, consistent with your own objectives and circumstances.

In the planned program, ECPD suggests that consideration be given to the following six points during the "First Five Years":

1 Career Orientation	4 Responsible Citizenship
2 Continuing Education	5 Selected Reading
3 Professional Identification	6 Personal Appraisal

ECPD points out that you should recognize that there are three distinct units of community life which contribute to the favorable climate necessary for your optimum professional growth. These are: (1) Your employer and the related industry; (2) the engineering societies, both local and national; and (3) the college or university serving your community.

Each is related directly to several points of the suggested six-point program. But, for a well-rounded program, all three are needed.

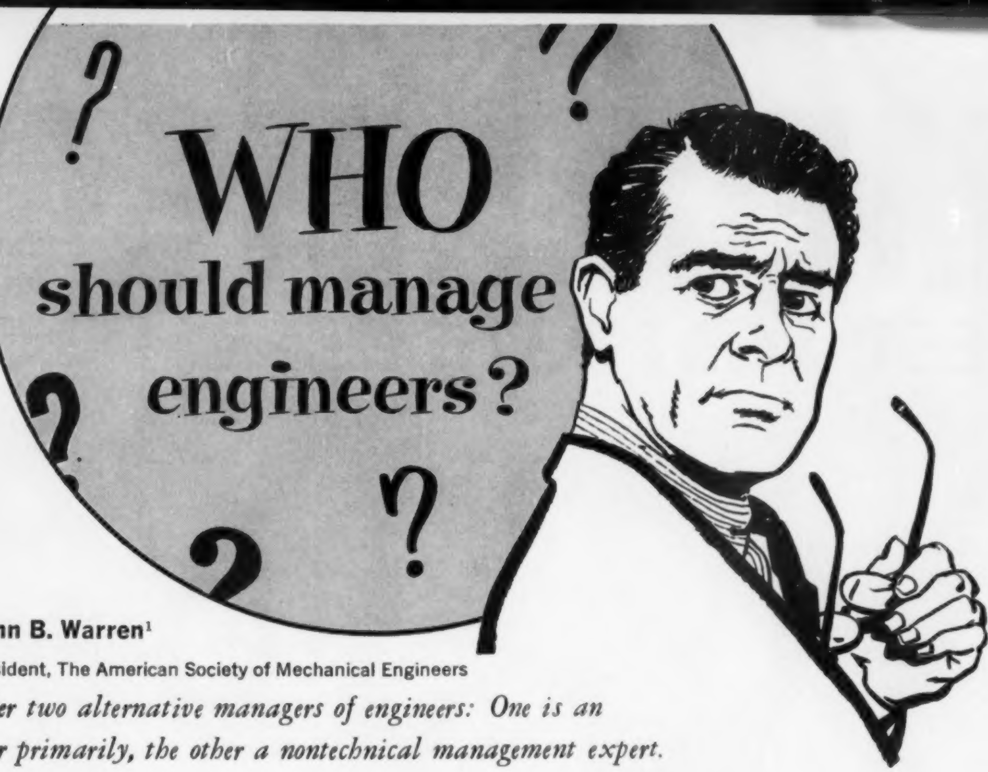
Your employer especially has, or should have, a deep interest in your professional growth. He should recognize that the greatest asset of any enterprise is its trained people and that there is always a shortage of top-flight personnel. He should be bringing capable young men up through the organization by helping them develop their capacities to the utmost.

The First Five Years Program has caught on in several cities . . . and a number of industrial firms are actively supporting it.

A special brochure addressed to young engineering graduates has been prepared by the Council and contains details of the program. To realize your full potential as a professional man it is recommended that you get a copy of "The First Five Years" from ECPD, Engineering Societies Building, 29 West 39th Street, New York 18, N. Y. Price: 10 cents a copy. It may be the best 10-cent investment of your professional engineering career.—*J. J. Jaklitsch, Jr.*

Editor, J. J. JAKLITSCH, JR.

WHO should manage engineers?



By Glenn B. Warren[1]

Past President, The American Society of Mechanical Engineers

Consider two alternative managers of engineers: One is an engineer primarily, the other a nontechnical management expert.

Why must engineers be concerned with management? Throughout an engineer's career he is either being managed or managing: In reality, in most cases both. In other cases he is aiming at or has arrived at a career in specific or general management for which he may be well fitted. Certainly the effectiveness of his work, his happiness, and his rewards will depend greatly on the quality of the management environment in which he participates.

This concern with management and administration of engineering itself has been increased by the growing complexity and magnitude of the scientific and engineering projects and enterprises of this dynamic age. Whereas forty years ago an engineer dealt with problems involving perhaps ten to 100 people and thousands to a few millions of dollars—and generally of a relatively simple technical level—today his problems are frequently from ten to a hundred times greater in magnitude, complexity, risk, and depth of technology.

Among the problems being posed are:

Are Engineers a Part of Management?

Should engineers be managed by engineers or nonengineers—or, perhaps more correctly stated, should the really creative engineers be managed by administrative-type engineers or nontechnical management people? Or, on the other hand, should the administrative function be a service function to the creative function?

Should engineers—when working as engineers—be confined to individual type of work, with their work integrated by manager-type people; or in an engineering project can the top engineers manage and direct the engineering aspects of the job, leaving the administrative details to a service function?

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Condensed from a luncheon address delivered at the 7th Annual Engineering Management Conference, Los Angeles, Calif., Sept. 17–19, 1959, sponsored jointly by the American Institute of Electrical Engineering and The American Society of Mechanical Engineers.

The Individual Engineer

Looking at these questions from the standpoint of an individual engineer's career:

1 He may, and usually does, start his career as an individual working on a specific project under proper supervision.

2 He may then either continue at this with progressively more important and complex assignments, or:

3 He may become an important creator of projects and achievements; that is, an outstanding specialist or expert, or again:

4 He may, as he gets more mature, transfer to management-type work—usually but not always that in an engineering project or company, or:

5 He may as a young man with his engineering-training background start in on the lower rungs of supervisory, managerial-type work, and continue up the ladder in more or less complete managerial work as his abilities and opportunities permit, leaving technical decisions and work to others, or:

6 And here is a sticky one! He may start in as an individual engineering worker, and then as his abilities develop and as his top management begins to have more confidence in his technical engineering leadership, he may be given directive or supervisory control over a number of other engineers and nonengineers on a project, section, or department of the work of which he is a part. He may still be expected, because of his peculiar talents, to continue to make engineering contributions and decisions of the highest order, and/or direct studies, calculations, evaluations, tests, or constructions which are so complex or large in magnitude as to be beyond his individual capacity to carry out. He may have been put in this position because of his unique ability to do this. Then, under these conditions, management theory poses the question—is he an individual engineer worker or is he a manager? Should he be expected to exercise all the prerogatives and responsibilities of management while carrying a technical load, or should he be given ad-

ministrative service assistance? As time goes on, as he matures, he may take on furthur management and possibly general-manager responsibilities, relinquishing then the technical load more completely to others whom he may have trained in the process.

The various career paths just listed need to be studied to see that the rewards, both in monetary values, in prestige, and in credit terms are commensurate with the real contributions in each individual case. Two previous speakers have expressed it eloquently in the phrase "Responsibility, remuneration, and recognition," and in the statement, "Status symbols that now only belong to management must go to technology's top people."

What is the most effective and proper role for top-level engineering staff work in a decentralized, highly engineered, and diversified business in its relation to the line engineering organizations? This involves the ever-present stresses between line and staff—the problems of using the relatively few outstanding and creative people who are available to any organization over as broad a range as possible, and still securing the needed engineering competence in depth in each of the "lines" of the organization.

The problem is one of (*a*) doing the job most effectively, (*b*) using the genius of our trained people most effectively, and (*c*) developing people most effectively so as to permit a full expression of their own capacity to express themselves and to make their own personal contributions—particularly their creative contributions.

Present Thinking

The new and growing profession of mangement in some cases would reduce the engineer to a worker position. Unionization tends in the same direction. There is some thought that management problems, as such, are the same in all kinds of business irrespective of engineering content, and that therefore either engineers do not make good managers, or that to use them as such is to waste good technical talent. In many individual cases, this is undoubtedly true.

Many able men have been giving this matter of management careful thought. I have read a great deal on this subject, but probably only a fraction of what is available. The conclusions, however, in almost all cases seem to be drawn in a deductive or *a priori* manner; that is, "by reasoning deducing consequences from definitions or principles regarded as self-evident." In short, these are usually only self-evident to the writer who sets himself up as an authority.

Consider the history of this type of reasoning and its later changing evolution in physical science.

This *a priori* technique was how we reasoned prior to about 1625, that is, deductively, and we had made little progress from the time of the Greek philosophers through the next 17 centuries.

Then Francis Bacon, an English nobleman, wrote and taught (as quoted from the Universal Standard Encyclopedia) "that truth is not derived from authority, and that knowledge is the fruit of experience."

Bacon's method was to infer by use of analogy, from the characteristics or properties of a single datum (or few data) the characteristics or properties of the larger group to which the datum (or data) belonged, leaving to later experience the correction of (then) evident errors. This method, making possible more boldness in the promulgation of hypotheses, was a fundamental precondition for the advancement of science. "Bacon did much toward imbuing science with the spirit of unbiased and accurate observation and experimentation."

(It is significant that Roger Bacon, another man altogether and an English monk, made similar proposals 400 years earlier, but they are so radical, and violated so much the accepted authorities' opinions, that he spent two separate ten-year periods essentially in prison for his beliefs.)

For centuries prior to Francis Bacon, men were bound and circumscribed in their thinking of natural phenomena by the pronouncements on these matters by old authorities, both secular and religious. Only after Bacon, however, did they begin to go to nature and to man, and to observe how things were, not how they thought they ought to be. Then they began to put these observations together; to extend them by setting up trials and experiments; and out of these observations came tentative conclusions and hypotheses. These were then tested against new observations and experiments, confirmed or modified, and thus we got our physical and gradually our social and psychological law, theories, and conclusions. This way leads toward truth; and the progress which then slowly gathered way in the scientific and engineering world has now resulted in the crescendo of change and progress that we see all around us on every side today.

We are about at the time and place in the Science of Management that the study of physical science was in Bacon's time. This is, I believe, particularly true in the management of scientific and engineering work, because of its newness.

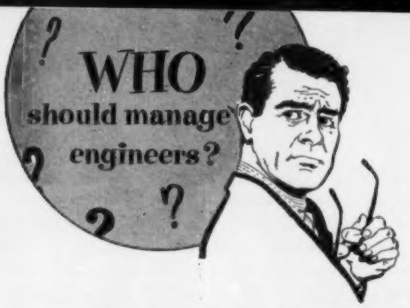
An Ancient Art

Management as an art is old, particularly in the political and military realm. Jethro, father-in-law of Moses, set down the principles of effective management by decentralization and delegation of authority to Moses in Genesis 4000 years or so ago. On the whole, of course, practical experience has borne out the wisdom of these principles.

We are making progress in developing a management science. We have recently begun the case-study method, but to a great extent as isolated individual cases. In accordance with this method, a new paper on "Authority Structure and Organization Effectiveness" appeared in *The Administrative Science Quarterly* of June, 1959, by Amitai Etzioni of Columbia University, in which he states:

"The study of organizations has proceeded mainly on two levels. Studies are devoted either to case descriptions and analysis, or to high-level generalizations and speculations on organizations in general. There is relatively little systematic examination on the middle level, as, for example, the study of various types of organizations. Propositions believed to hold for all organizations have to be tested separately for each organizational type. . . . Three major generalizations are . . . (*a*) in the ultimate analysis, staff authority is subordinate to line authority; (*b*) organizational units, especially the organization as a whole, are therefore headed by managers and not by experts; (*c*) organizations have one and only one ultimate center of authority."

In this excellent paper, he is studying by numerous case histories the proper role of the "manager type" and the "expert type" for which the engineer will usually qualify.



"The organizational goal of private business is to make profits. The major means are production and exchange. While experts deal with various aspects of the production and exchange process—that is, with means such as engineering, labor relations, quality control, and marketing—the manager is the one who co-ordinates the various activities in such a way that the major organizational goal will be maximized. Profit making is his responsibility. . . . In general, the goals of private business are consistent with managerial orientations."

Etzioni "would like to suggest that in professional organizations the staff-expert, line-manager correlation, in so far as such a correlation exists at all, is reversed. Although manager orientations are suitable for the major goal activities in private business, the major goal activity of professional organizations is, in its nature, expertness.

"Managers (or administrators) in professional organizations are (mainly) in charge of secondary activities; they administer *means* to the major activity carried out by experts (i.e., the professionals). In other words, if there is a staff-line relationship at all, experts constitute the line (major authority) structure and managers the staff. Managers give advice about the economic and administrative implications of various activities planned by the professionals. The final internal decision is, functionally speaking, in the hands of the various professionals and their decision-making bodies.

Not Solely for Profit

Many of our management problems and strains in the engineering field are being brought about because—due to the complexity and growth of the engineering problems in many large businesses, particularly in the heavy machinery field; in the defense; in the newer electronic, aeronautic, computer, power, and nuclear fields—these businesses can no longer be said to be organized and run solely for the profit-making functions, but they must be more service-and-product oriented. They become, therefore—or at least parts of them—more nearly like the "professional organizations" that Etzioni writes about, and must be more largely headed and guided by professional or expert-oriented men.

As proof of this, consider the following figures from the General Electric Company today—a large business organization working, to a great degree, in the complex heavy machinery, electronic, nucleonic, computer, power, and defense fields. Of 5 top operations officers, 4 were engineering-trained, and 4 practiced engineering. Of 16 division heads, 9 were engineering-trained, and 6 practiced engineering. Of the 103 business or department general managers, 73 were engineering or scientifically trained and 58 so practiced at one time.

Data made available by the ASME staff indicate that about 12 per cent of the total membership of the four Founder Societies at the present time occupy positions that are classified as board chairmen, presidents, vice-presidents, general managers, etc., of corporations. This actually means, of course, that almost 30 per cent of the full Member grade of these societies occupy such positions in their companies.

While we are beginning to grapple with these problems, we might go about continuing the study by:

Setting up a task group to guide the over-all approach.

Have panel discussions, but, to make these most effective, have records kept and perhaps publications made in abstract.

Undertake to find out in detail what we need to know, prepare a questionnaire which could be sent out to a large number of engineering organizations to see how they are doing this job—what kind of men they have in the controlling positions.

Invite the top engineering managers, and perhaps the general managers of several companies, to present their methods of managing engineers—that is, present the ways they are doing it, not necessarily the ways they are supposed to do it. This should cover not only highly successful businesses, but also less successful ones as well, in highly engineered product lines and in less highly engineered lines.

From Art to Science

The following ideas were set forth by Harold Smiddy and the author in a paper presented to the Management Division at the 1955 ASME Annual Meeting in Chicago:

"Management up to relatively recent periods has been largely an art. It is still in the early stages of becoming a science. A true science in today's meaning of the term means that we must postulate and then try to test the system that we postulate. We then are guided in our next step by the results of the preceding. Since management is not yet an exact science and since no art is exact, it must mean that there are as yet many different solutions to most of management's problems. Some are bound to be better than others.

"True science only results when these multiple solutions are all put to the test of use, when the results are measured, and the judgment as to which of the various avenues of approach are best rests upon the results of the experience. The decision in such a true science can be founded only on the exercise of experienced judgment on the basis of the results of measurements of some kind. Any measurements which deal with the multiple variables of human nature are, of course, especially difficult and uncertain. But even so, to solve these problems presented by the current trends in management, necessitated as they are by this continuing explosion of our technical and economic world, will require our utmost resourcefulness in setting up to make these measurements, and then forming these judgments in spite of our inability to control all the variables in order that we may determine the direction in which we should progress."

Conclusion

We have an opportunity, here. We owe it to our members, to all of the engineering profession, particularly to our younger engineering people coming up—and to our nation—to get at a real understanding of the engineering management problems. We need to do it to optimize our effectiveness and to optimize the satisfaction and rewards of the members of our profession. This is a matter that cuts across all engineering disciplines, and hence deserves joint efforts in its solution, as you are endeavoring to do here. Then, after we collect the evidence and analyze its implications, we need to teach what we find to be true.

If philosophy seems obscure, it is because it tackles the really difficult problems that haven't yet yielded to the scientific method

BEYOND THE CAPTURED TERRITORY

By Martin Goland, Mem. ASME
President, Southwest Research Institute, San Antonio, Texas

ENGINEERING, by its very definition, occupies a singular role in bridging science and technology with the broader pattern of human affairs. An advertisement issued recently by the Engineers Joint Council contains the phrase, "engineers apply the sciences to give people use of nature's materials (and) forces." While this is necessarily an oversimplified description of a complex profession, it nevertheless makes clear the concern which the engineer should have, both with the intellectual advance of science and with the society it serves. Whether by spoken word or inner thought, each of us strives continually to see more clearly the relationship between engineering and over-all human need.

Moral and Spiritual Values

An inevitable parallel to the growth of science and technology has been an increasing concern for the moral and spiritual values which accompany material progress. The classic conflict between science, philosophy, and religion—now largely resolved, it is safe to say—was the result of misconception and circumscribed thought. But even in the modern view, doubt exists in the minds of many whether mounting force and efficiency can ultimately be blended with the inner tranquility we all seek.

The origins of engineering are to be found in the traditions of the craftsman, while today a strong trend has set in in favor of the scientific practice of engineering. There are many, in fact, who believe that the scientific pendulum has swung too far, and that modern engineers are too heavily schooled in scientific formalism, while losing the touch of the craftsman.

The paradox of our age is the successful blending of science and society. In view of this, never has it been more important to reaffirm the fundamental values of the traditional engineer. Spanning theory and practice, concept and use, where better than to the engineer should we look for the leadership so desperately needed to guide science into channels of lasting human value? It is the engineer who daily blends the artificial perfection of the scientific method with the imperfect compromises demanded by reality. Who else has so acute an understanding of the physical world and of its implications for benificence or evil? The cultural heritage of engineering, above all other avenues of human pursuit, impinges with greatest force on the central questions of our times.

In the ultimate perspectives of history, the greatest challenge for the engineer may yet lie ahead. The balancing of material achievement against social vision—the tempering of cold logic with warm human emotion—through such synthesis the engineer may reach his highest pinnacles of achievement.

Let me digress for a moment by quoting a passage from Will Durant's book, "The Story of Philosophy." When I was a student engineer, I can still recall the polite contempt with which my classmates and I viewed the apparently confused intellectual wanderings which characterized the liberal arts. Philosophy, in particular, seemed (in the words of Durant) "as useless as chess, as obscure as ignorance." Such words as esthetics, ethics, politics, and metaphysics—branches of philosophy—were to be avoided since they could not be exploited with precalculated profit. Three decades ago, in advance of the nuclear age, we could still be content to build machines and forget their operators.

It was with the force of revelation, therefore, that I read, some years later, the introduction to Prof. Durant's book. In one passage he writes: "Science seems always to advance, while philosophy seems always to lose ground. Yet this is only because philosophy accepts the hard and hazardous task of dealing with problems not yet open to the methods of science—problems like good and evil, beauty and ugliness, order and freedom, life and death."

Philosophy Is the Spearhead

And later came these words, the theme for this talk: "Science is the captured territory; and behind it are those secure regions in which knowledge and art build our imperfect and marvelous world. Philosophy seems to stand still, perplexed; but only because she leaves the fruits of victory to her daughters the sciences, and herself passes on, divinely discontent, to the uncertain and unexplored."

For his historic treatise founding the science of mechanics before the Royal Society in 1686, Sir Isaac Newton chose as his title, "Philosophiae Naturalis Principia Mathematica" (Mathematical Principles of Natural Philosophy). The technical disciplines of engineering were born from the speculations of the philosopher; the ever-greater meanings of our profession are still obscured within the same uncertain probings. Should not we, as engineers, dedicate ourselves to the search for a new maturity, in which machines and people are at last truly ennobled?

Condensed from a speech delivered at the Petroleum Luncheon of the Summer-Annual Meeting, Dallas, Texas, June 5–9, 1960, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

By C. M. Honaker[1] and D. F. Bruce[2]

GAS-TURBINE ELECTRIC PLANT IN VENEZUELA

This Oil Company considered three prime movers for its remote power station, and settled on the gas turbine. Presented here are the original design objectives, plus a later evaluation.

By the end of 1951, the electrical load in the Southern or Oficina area of the Mene Grande Oil Company had been carefully limited to 2300 kw under peak conditions, with an installed generating capacity of 3420 kw, and a firm capacity of 2420 kw. Power was supplied by two plants, each having three generators driven by gas-fired internal-combustion engines, connected by a single-circuit 33-kv transmission line. The major system load came from the camp facilities, while loads totaling 9000 kw, consisting of increments of 100 hp or less, were being powered by small internal-combustion engines.

Expansion Plans

Plans for future installation of gas-injection, gasoline, water-injection, and pipeline-pumping plants made a study of anticipated power requirements and sources mandatory in 1952. The addition of facilities as loads developed would involve high capital and operational costs. No outside operating companies were interested in building power facilities for the sale of large blocks of wholesale power. A transmission line to a steam plant at Jusepin, state of Monagas, would cost about $2,222,000, and the anticipated purchase price of power at the steam plant would be higher than generation and transmission costs for a company-owned central power plant.

These considerations led to the decision to build a complete system which now represents a capital investment of over $12 million, including the cost replacement of engine drives for pumping. The system is completely isolated. There is no interconnection or outside sale of power, and the only alternate sources of power are two small gas-engine generating plants used for pumping-station stand-by.

Choice of Prime Movers. Gas turbines were selected as prime movers because of low initial cost, low water requirements, and low operational and maintenance costs, Table 1. The use of waste heat was not considered feasible because heat loads in sufficient quantity were not concentrated near the various prospective plant sites. The decision to use gas turbines was a bold one since this plant was to be, and possibly still is, the only isolated generating station using gas turbines exclusively for prime movers.

Choice of Plant Site. The plant site chosen at West Guara had a suitable and plentiful gas supply which did not require excessive pipeline facilities. It was near camp facilities and centrally located with respect to

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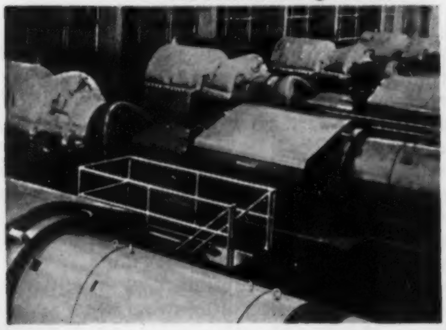
[2] Industrial Gas Turbine Engineering, Westinghouse Electric Corporation, Lester Branch, Philadelphia, Pa. Mem. ASME.

Contributed by the Gas Turbine Power Division and presented at the Annual Meeting, Atlantic City, N. J., November 29–December 4, 1959, of The American Society of Mechanical Engineers. Condensed from Paper No. 59—A-191, originally entitled "25,000-Kw Mene Grande Gas-Turbine Installation."

Fig. 1 The turbine room of the central power station includes five 5000-kw turbogenerators



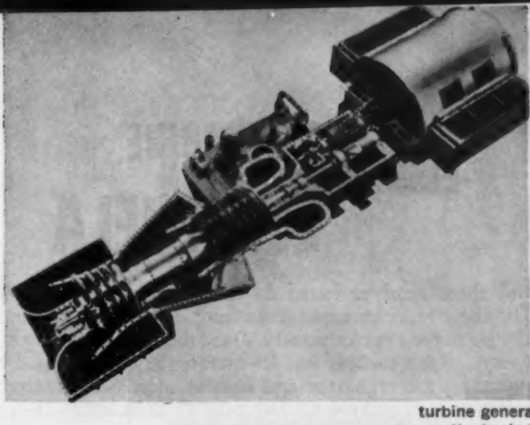


Fig. 3 The W-81G gas-turbine generator used as the basic 5000-kw unit

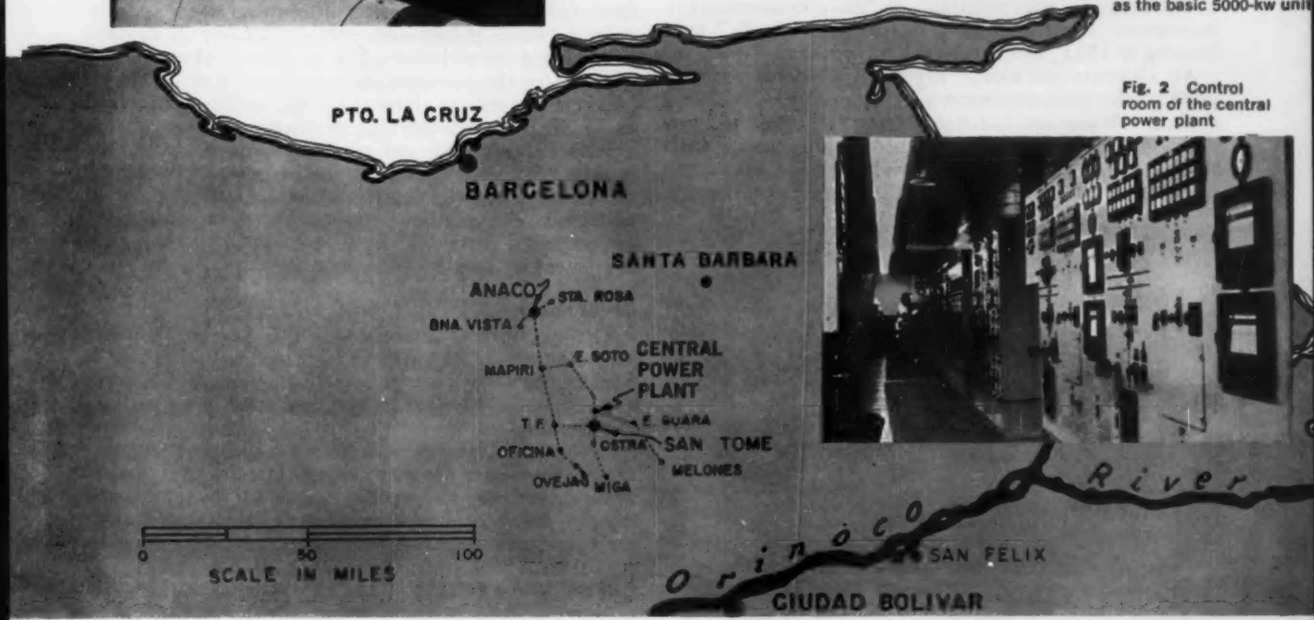


Fig. 2 Control room of the central power plant

anticipated future loads and had suitable water in limited quantity.

The original plant consisting of three 5000-kw turbogenerators and substation was completed in the latter part of 1955. A fourth unit was added in 1958 and the fifth was placed on the line May 1, 1959, Fig. 1.

The Central Power System. The Central Power System includes the central power plant and its substation; 144 miles of 69-kv transmission lines, 13 miles of 33-kv transmission; nine 69/13.8-kv substations, one 69/2.4-kv substation, and five 34.5/2.4-kv substations. Four 69-kv transmission lines leave the power-plant switchyard. Two of these are radial feeders and two are looped feeders. Two additional 69-kv lines radiate from points in the loop. Local power requirements near the central power plant are provided for by a 5000-kva, 69/13.8-kv transformer bank located in the power-plant switchyard. Major loads include camp facilities, water stations, pipeline pumping stations, gasoline plants, gas-repressurization plants, and oil-well pumping units. Oil-well pumping accounts for an ever-increasing portion of the system load, at present totaling more than 13,000 connected horsepower. Maximum hourly gross generation to date: 16,600 kwhr.

Central Power Plant

Provisions for simple expansion were included in the design. The unit theme was followed throughout with each turbogenerator having its own gas compressor, cooling tower, step-up transformer, station service transformer, and generator oil circuit breaker. Generation voltage is 4160, stepped up to 69 kv by unit transformers and fed to the 69-kv station bus through unit-generator oil circuit breakers. The substation is equipped with a 69-kv transfer bus and spare oil circuit breaker arranged so that substitution for any generator or feeder breaker can be accomplished.

Primary fuel source is the gas from the West Guara gasoline plant located nearby. Incoming gas at 45 psig is compressed to 200 psig by electric-motor-driven reciprocating compressors and routed through aftercoolers

Table 1 Estimated Installation Costs

ITEM	5-3000 KW GAS ENGINE POWER PLANT	3-5000 KW STEAM TURBINE POWER PLANT	4-4000 KW GAS TURBINE POWER PLANT
GROSS CAPITAL PLANT	$ 3,675,000	$ 3,330,000	$ 2,900,000
DISTRIBUTION SYSTEM	800,000	800,000	800,000
TOTAL INVESTMENT	$ 4,475,000	$ 4,100,000	$ 3,700,000
INSTALL CAPACITY – KW	15,000	15,000	16,000
FIRM CAPACITY – KW	12,000	10,000	12,000
COST INSTALLED CAPACITY	$ 245 / KW	$ 220 / KW	$ 181 / KW
ESTIMATED OPERATING COST INCLUDING DEPRECIATION	$.00946/KWH	$.00793/KWH	$.00711/KWH
ESTIMATED DISTRIBUTION COSTS	$.00063/KWH	$.00063/KWH	$.00063/KWH
ESTIMATED TOTAL COST/KW	$.01009	$.00855	$.00774

GAS-TURBINE ELECTRIC PLANT IN VENEZUELA

and three receiver tanks to the turbine-supply header. The three receiver tanks have sufficient volume to supply the plant for approximately 30 sec during emergency cutovers. Each turbine has its own surge tank located between its gas regulator and turbine inlet. Downstream pressure is regulated to 160 psig at each unit. Liquid elimination is accomplished by gas-compressor-inlet separators, aftercooler and receiver-trap drains, final heating to 120 F, and surge-tank blowdowns.

An alternate gas source, regulated to 45 psig, is supplied to the gas-compressor-inlet header by a local field system. Automatic cutover, during failure of the primary gas supply, is accomplished pneumatically with manual reset. Recently, a second alternate gas supply has been added to improve reliability during emergencies.

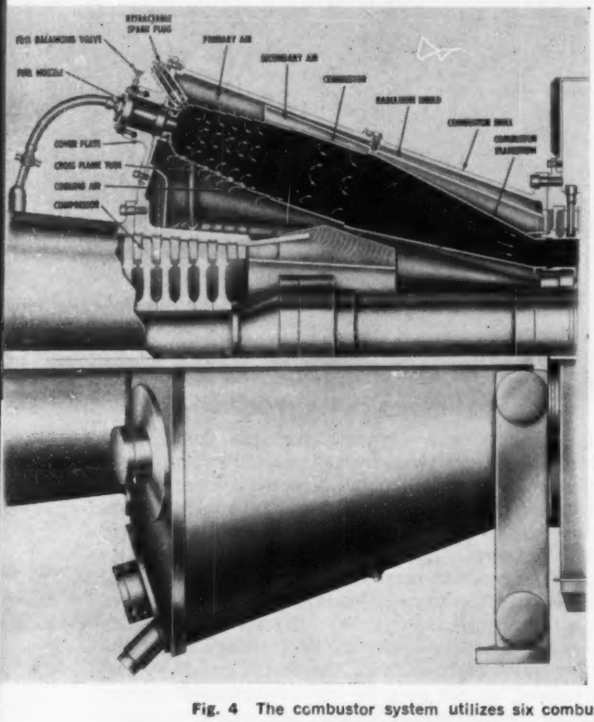


Fig. 4 The combustor system utilizes six combustors which are conically arranged between the compressor outlet and the turbine inlet

Gas at 1500 psig, by direct pipeline from two injection wells, is reduced to 180 psig and tied into a header between the gas-compressor discharges and the receiver tanks. This "floating" supply is so regulated that it cuts in on a compressor-discharge pressure drop to 180 psig and cuts out on a discharge pressure rise to 200 psig.

Plant water for cooling and miscellaneous purposes is supplied by pipeline from water wells. During the last plant extension a departure was made from unit design in order to eliminate excessive drift. Two forced-draft cooling towers were installed, each sized to supply the coolant needs of three generating units. In the future, the natural-draft towers will be for stand-by only.

Emergency start-up power is provided by a 2400-volt generator driven by a reciprocating gas engine. This equipment was salvaged from the original generating stations and has been the least reliable part of the plant.

Direct-current control power is supplied from one 120-volt Plante-style station battery equipped with a selenium-rectifier charger. Future plans include the installation of a Ni-Cad battery and motor-generator set to supply control power for the 4th and 5th units.

All controls, with the exception of push-button stations for gas compressors, cooling-tower fans, and circulating-water pumps are centrally located in the air-conditioned control room, Fig. 2. Included are remote controls for the pneumatically operated 69-kv oil circuit breakers and remote controls for the turbine-generators, in addition to the 480-volt switchgear for the station auxiliary equipment and the turbine-generator units. Although all 440-volt station service buses are linked by circuit breakers there is no provision for synchronization as regards the auxiliary buses. Therefore all sections are protected from dual feed by interlocks. Auxiliary equipment is driven by 440-volt motors.

Gas Turbines

The gas turbines installed at this power plant are Westinghouse Model W-81G machines with a rating of 5000 kw each. Each unit is a self-contained power plant and can be fully loaded from a cold start in a matter of minutes.

A shop-test view of a W-18G gas-turbine-generator, Fig. 3, illustrates the many design features available in these gas turbines such as: (*a*) Horizontal split single casing, (*b*) two-bearing construction, (*c*) absence of h-p air seals and bearings in hot-gas zones, (*d*) ready accessibility for inspection and maintenance of all parts.

Major Design Features. The axial-compressor portion of the rotating elements is toward the center, Fig. 3, and the turbine is at the left. The two are connected by the torque tube to form a single rigid shaft.

Fuel is injected into six combustors, Fig. 4, which are conically arranged between the compressor outlet and turbine inlet. A single horizontally split casing houses and locates the combustors and their transition pieces.

The auxiliaries of the gas turbine used in adapting it to this application consist of: (*a*) Main reduction gear, 5740/3600 rpm; (*b*) direct-drive oil pump mounted in main gear housing; (*c*) starting motor, 250-hp, 440-volt wound-rotor type; (*d*) primary auxiliary lube-oil pump, $7^1/_2$-hp; (*e*) secondary auxiliary lube-oil pump, 3-hp; (*f*) fuel-control system.

The control scheme is arranged for semiautomatic operation and requires but one man to operate all the units from a central control room.

The fuel-control system consists of a speed-sensing element (reverse-flow impeller), speed changer (used to position a pin thereby loading the governor spring), hydraulic governor, hydraulic servomotor (used to position a fuel-control valve), and a fuel-control throttle valve, Fig. 5.

Operating Experience

Availability and Reliability. On June 1, 1959, the Central Power Plant had been in operation 38,944 hr with an accumulated 118,504 machine hours. Availability for the five turbines was 89.1 per cent, and reliability 99.98 per cent, Tables 2 and 3.

Automatic speed controls, load-division, and bus-voltage controls are not incorporated at present, but are being reviewed for possible installation at some future date. Speed and frequency are controlled manually, by the native operators, with little difficulty. Speed can be maintained easily within ±0.2 cycle during normal operation and the machines can be synchronized smoothly. The turbines respond promptly to speed changes exceeding 0.06 per cent. A master clock, checked daily by radio signal is used as a base for comparison and control of frequency. Load division between turbines is adjusted manually by use of the speed changers.

An underfrequency relay set to close on frequency drop to 56 cycles guards against station overload. Presently, this relay trips all 69-kv feeder breakers to reduce load. The advisability of using selective tripping on underfrequency is under consideration.

Operating Costs. Gross generation from the startup of the Central Power Plant to April 20, 1959, totaled 264,267,923 kwhr at a cost of $2,528,985 (includes maintenance, overhaul, and depreciation) or $0.00957 per kwhr. The cost breakdown for a representative year (1958) is shown in Table 4.

Repair and Maintenance Costs. The determination of the true cost of maintenance and repair alone is not possible since these are lumped with operating expense in the company's accounting system. The major turbine and generator parts that have been replaced since the plant became operational are listed in Table 5. No blading replacements have been made aud none are anticipated during the second overhaul.

The itemized expense incurred during the overhaul of turbines 1, 2, and 3 in early 1957 is shown in Table 6. Gross generation up to that time totaled 92,229,100 kwhr with 36,011 machine hours.

Manpower Requirements. A complement of 11 national and one foreign plant foreman constitutes the normal work force at the central power plant. A regular shift consists of a control-room operator, who is responsible for plant operation during his turn, and a gas-compressor-room operator. One mechanic is used exclusively for maintenance. The relief operators aid in maintenance work during the 3 days per week that they are non-operational. Plant cleanup and general maintenance work are done by two laborers, who also substitute for operators during vacations, sickness, or emergencies.

Turbine and generator overhaul has presented somewhat of a problem because of the lack of experienced men. At present, overhaul is being accomplished by five men (one mechanic and four laborers, not part of the plant complement) in addition to the plant mechanics, under the supervision of a manufacturer's service engineer.

Future Plans. Plans for the immediate future do not include an increase in generating capacity. However, these plans are subject to frequent changes since they are dependent upon the marketability of oil. In the opinion of the authors, additional units will be identical to those already installed. A unit capacity of 5000 kw represents a reasonable increment of power both for loading and stand-by as regards this system.

Identical units also alleviate the spare-parts problem in this remote area.

Design changes such as automation, the addition of a second plant battery, and selective feeder tripping on plant overload are constantly being considered. The basic plant design is considered sound, workable, and reliable.

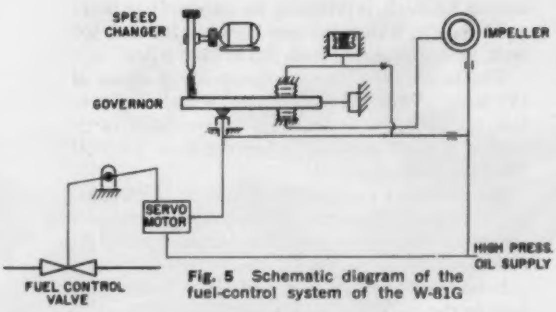


Fig. 5 Schematic diagram of the fuel-control system of the W-81G

Table 2 Turbine Availability[a]

TURBINE	HRS. GENERATION (A)	HRS. READY (B)	HRS UNSERVICEABLE (C)	TOTAL
1	29,564	5581	3799	38,944
2	27,937	3448	4927	36,312
3	23,697	6857	2902	33,456
4	6,944	1070	890	8,904
5	396	136	356	888

[a] Per cent availability = (A+B×100)/(A+B+C)

Table 3 Plant Outages Chargeable to Turbine

DATE	TURBINE	DURATION (HRS.)	PROBABLE CAUSE
APRIL 15, 1955	2	0.17	THROTTLE VALVE SERVO-MOTOR RELAY STUCK
MAY 1, 1955	2	2.67	FAULTY REGULATOR OF CONTROL AIR
OCTOBER 17, 1955	3	0.17	DIRT IN CONTROL AIR FILTER
AUGUST 1, 1956	3	0.57	DIRT IN CONTROL AIR FILTER
AUGUST 7, 1956	3	0.82	DIRT IN CONTROL AIR FILTER
FEBRUARY 25, 1957	3	0.72	THROTTLE VALVE SERVO-MOTOR RELAY STUCK
DECEMBER 26, 1958	4	0.80	UNKNOWN
	TOTAL	5.92	

Table 4 Operating Expenses, 1958[a]

ITEM	AMOUNT	COST $/KWH
LABOR AND TRANSPORTATION	$97,934	.00116
FUEL GAS	212,519	.00253
MAINTENANCE MATERIALS AND LABOR	52,616	.00063
OVERHEAD	5,565	.00007
DEPRECIATION	323,698	.00385
TOTAL	$692,332	.00824

[a] Gross Generation = 84,050,000 kwhr

Table 5 Major Turbine and Generator Repairs

NO.	ITEM	UNIT COST	TOTAL COST
12	COMBUSTOR BASKET	$1,077.57	$12,930.84
2	TRANSITION PIECE	$1,267.11	2,534.22
0	EXHAUST BEARING		
1	COMPRESSOR BEARING	538.20	538.20
2 SET	PINION BEARINGS	737.10	1,474.20
1 SET	EXHAUST TURNING VANES	500.00*	500.00
1	TAYLOR TRANSMITTER	549.90	549.90
1	HAGAN THERMOSTAT	643.50	643.50
ESTIMATED		TOTAL	$19,170.86

Table 6 Cost of First Overhaul (3 Units)

ITEM	COST	$/KWH GENERATED
LABOR AND TRANSPORTATION	$12,788	.00014
SERVICE ENGINEER	7,582	.00008
MATERIALS	3,104	.00003
MACHINE SHOP CHARGES	2,182	.00002
OVERHEAD AND INCIDENTIALS	2,215	.00002
TOTAL	$27,871	.00030

LEVACARS

WHY AND HOW?

By A. L. Haynes[1] and D. J. Jay[2]

Ford Motor Company,
Dearborn, Mich.

The Levacar, developed by Ford Engineering Research, is primarily for intermediate-range rapid transit, filling the gap between 200 and 500 mph, for trips ranging from 100 to 1200 miles.

Wheels are unsatisfactory for speeds in excess of 150 mph. Vibrations are set up, wheels begin to lose traction and to wear at unreasonable rates. Sliding is the alternative. And the most practical lubricant for sliding is air.

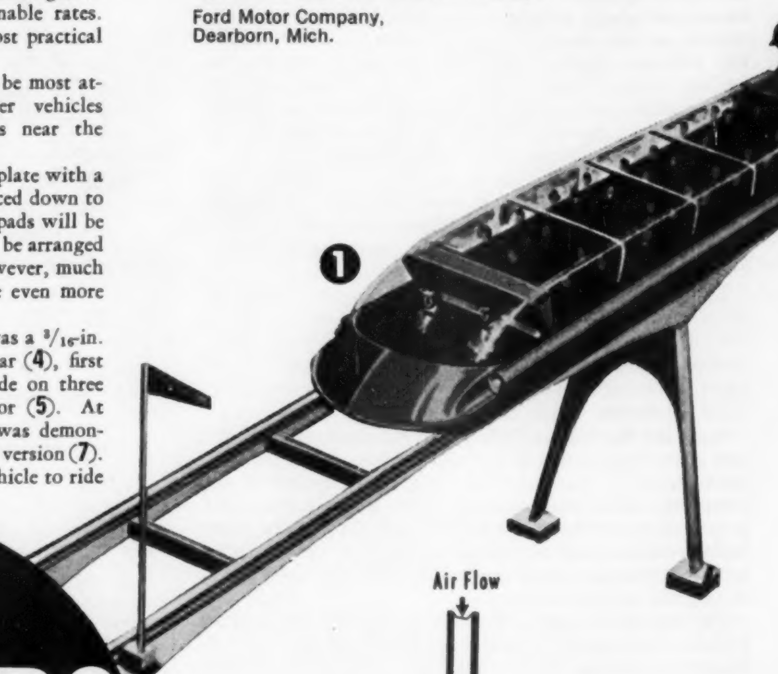
The Levacar's application appears to be most attractive as single-unit, multipassenger vehicles operating frequently between stations near the centers of terminal cities (1).

In its simple form, a levapad is a flat plate with a hole in the center and an air supply forced down to create a film of air (2). For rails, levapads will be used in slipper assemblies. These could be arranged to fit around a standard rail (3). However, much simpler rail configurations could prove even more satisfactory.

The first of Ford's levapad vehicles was a $^3/_{16}$-in. scale model of a four-passenger Levacar (4), first demonstrated on April 1, 1958. It rode on three levapads fed by an external compressor (5). At the same time, a triangular platform was demonstrated (6), and later a more streamlined version (7).

On Feb. 29, 1960, the first levapad vehicle to ride on a rail was demonstrated (8). It now rides on a rail 28 ft in diam and develops speeds in the 15–20 mph range.

The rail-load test stand (9) applies loads to levapad slippers on two axes and in both positive and negative directions. It can test the effects of static loads on slippers of many designs. The test stand is used to evaluate slipper designs on various novel rail cross sections.



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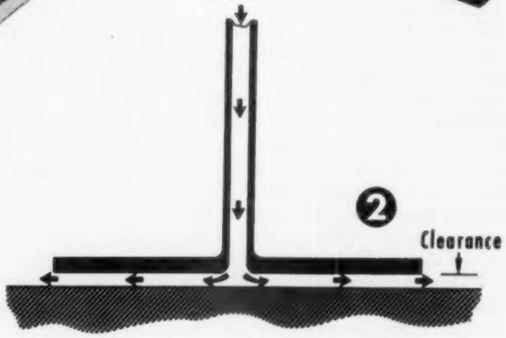

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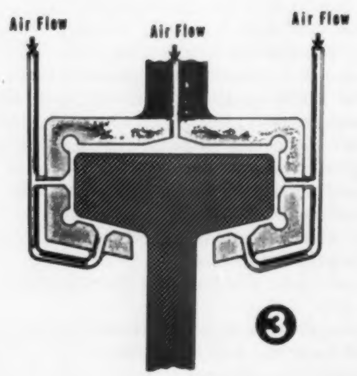

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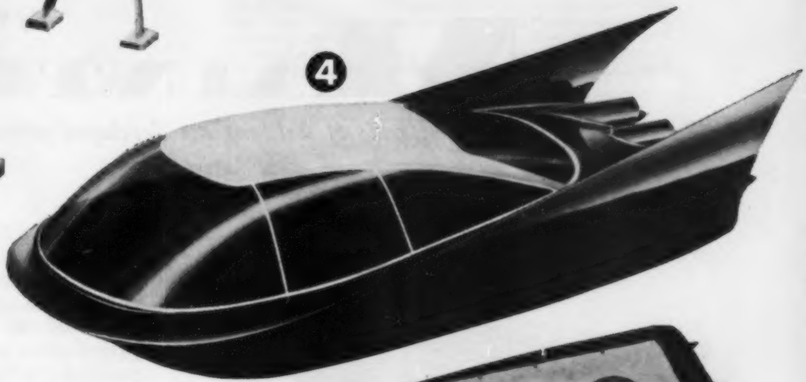
[1] Director, Engineering Research and Advanced Product Study.

[2] Principal Research Engineer, Associate, Levacar Project.

Contributed by the Aviation Division and presented at the Aviation Conference, Dallas, Texas, June 5–9, 1960, of The American Society of Mechanical Engineers. Condensed from ASME Paper No. 60—Av-5.



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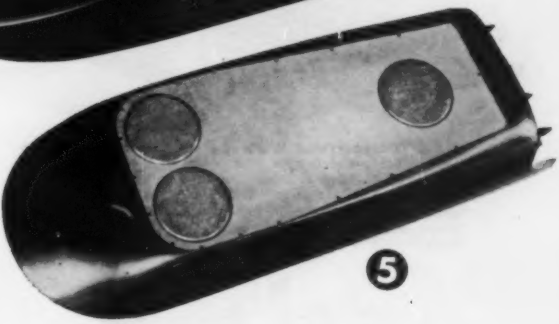

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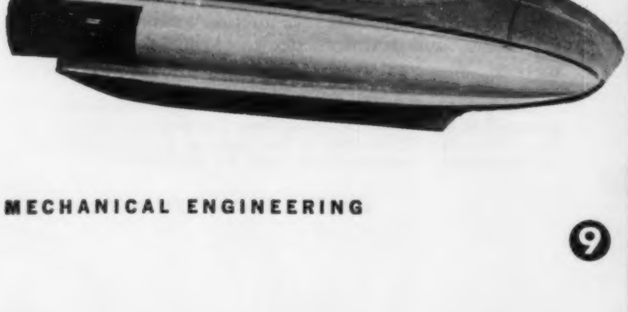

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By W. H. T. Svanoe, Engineering Department,

Maintenance

New methods of welding are developed primarily for production, but they have

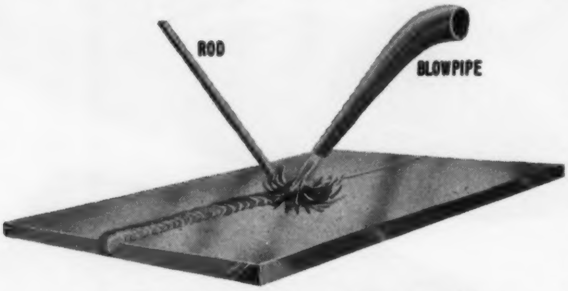

Fig. 1 Oxyacetylene Welding. Oxygen and acetylene are mixed in the proper proportion in a simple welding torch designed to give the welder control of the flame. The flame temperature in this 40 or 50-yr-old technique is about 6000 F. Although replaced by newer methods in many uses, it is still very acceptable for maintenance work.

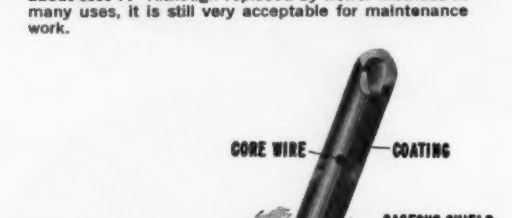

Fig. 2 Shielded Metal-Arc Welding. Heating and melting are produced by an electric arc between a covered metal electrode and the workpiece. The molten electrode material passes through the arc in droplet form and unites with the base metal to form the welded joint. The gaseous shield formed by combustion of the coating protects the weld pool from O_2 and N in the air. Flux elements form a slag on the weld which protects it during cooling. Arc temperature is about 10,000 F.

Fig. 3 Tungsten Inert-Gas-Shielded Welding. Argon is generally used as the shielding gas because the molten puddle is brighter and there is better arc stability. When used with a-c there is a cleaning action. Oxides of aluminum, magnesium, and beryllium are reduced. In the d-c method used with other metals, cleaning plays no significant part, air is displaced physically by flowing inert gas, an arc is maintained between the tungsten electrode and the workpiece, and filler metal is added from a filler rod as in oxyacetylene welding.

The discovery that high-temperature gas and electric-arc flames could be used to melt and join metals has been of great significance in industrial progress. Techniques for oxyacetylene welding were well developed 40 to 50 years ago. Electric-arc welding gained great prominence with the advent of the coated electrode, which came into common usage about 30 years ago. Other processes, such as Thermit, electric-resistance, and so forth, were also in commercial use by that time, but the bulk of welding was done with the gas and the arc processes.

Since that time, there has been a steady evolution in processes and techniques of welding. New methods have been required for the additional metals and alloys that have come into widespread use. These were developed primarily to meet production needs in metal fabrication, but welding is also a vital tool in the maintenance of plant facilities and some of the methods which have application for this work will be reviewed.

Welding

Oxyacetylene Welding. Oxyacetylene welding, Fig. 1, has been replaced for many uses by faster and more economical methods, but it is still a very acceptable method for maintenance work. Widest use is in the welding of light-gage metal, in hard surfacing, and in brazing using copper and silver alloys.

Equipment is inexpensive and easily portable. High-quality welds are accomplished without difficulty. Oxygen and acetylene are mixed in the proper proportion in a simple welding torch which is designed to give the welder control of the welding flame. The flame temperature of about 6000 F is considerably higher than the melting temperature of most commercial metals, and thus may be used to produce the localized melting necessary for welding. Filler metal is added by melting the end of a welding rod into the weld puddle.

Electric-Arc Welding. In shielded metal-arc welding, Fig. 2, heating and melting are produced by an electric arc between a covered metal electrode and the workpiece. The molten electrode material passes through the arc in droplet form and unites with the base metal to form the welded joint. The combustion of the coating provides the gaseous shield which protects the weld pool from the detrimental effects of oxygen and nitrogen in the atmosphere, and the coating also contains elements which, after fluxing the molten metal, form a slag on the weld which protects it during cooling. The temperature of the arc is about 10,000 F which permits rapid welding.

Electric-arc welding with coated electrodes has its greatest use in maintenance in the welding of carbon, low-alloy, and stainless steels. With the electric-arc method, high-quality welds may be made in all positions.

Contributed by the Maintenance and Plant Engineering Division and presented at the Maintenance and Plant Engineering Conference, St. Louis, Mo., April 25-26, 1960, of The American Society of Mechanical Engineers. Condensed from Paper No. 60—MPE-4.

E. I. du Pont de Nemours & Company, Inc., Wilmington, Del.

WELDING

their application to problems of maintenance

Recently, iron-powder electrodes, in which substantial amounts of iron powder are added to the coating, have been introduced. The iron-powder deposits in the weld pool together with the core wire during welding. Along with the higher amperages possible with this electrode, this results in welding speeds on low-carbon steels up to 100 per cent greater than for conventional coated electrodes. Because of the fluidity of the puddle, however, use is limited to welding in the flat position.

The equipment, materials, and techniques of coated-electrode welding have reached a high stage of development and the bulk of maintenance and fabrication work today is done with this method.

Nonconsumable-Electrode Inert-Gas-Shielded Welding. In welding with a tungsten electrode and inert gas, Fig. 3, argon is generally used as the shielding gas because the molten puddle is brighter and there is better arc stability. When used with alternating current, this gas also acts to remove oxides on aluminum, magnesium, and beryllium copper.

In welding other metals, this cleaning action plays no significant part, and d-c straight polarity can be used with excellent results. In this method, air is displaced physically by flowing inert gas, an arc is maintained between the tungsten electrode and the workpiece, and filler metal is added from a filler rod as in oxyacetylene welding.

Weld quality is of a very high order, and practically all commercial metals can be welded. Welding speed, in general, is not as high as with coated electrodes, but there is considerable value for maintenance welding, particularly when extremely light-gage materials are to be welded. In addition, weld control is better. Pipe joints may be made, for example, with a root bead which feathers almost perfectly into adjoining pipe walls with much less protrusion than with other manual methods. This is particularly true when a gas "back-up" is used in conjunction with the process. In the chemical industry this method is used extensively to weld piping of aluminum, stainless steels, Hastelloy, nickel, Monel, and silicon bronze.

Back-up with inert gas is not difficult. The pipe is merely plugged on each side of the section to be welded, purging is done with inert gas through suitable connections, and gas continues to be introduced during welding. Good welds may be made in stainless-steel pipe when using nitrogen. In addition to control of the internal root bead, the gas holds the oxide formation to a level low enough to permit its use for many process services without the need for subsequent pickling or cleaning.

An interesting adaptation of this method has been the development of inert-gas spot welding. A gun, resembling an automatic pistol, produces high-quality spot welds in all positions with a tungsten electrode. Metals up to $^1/_{16}$ in. or more in thickness may be welded to any thickness when the welding can be done from the side of lighter gage material.

Fig. 4 Consumable-Electrode Inert-Gas-Shielded Welding. As in tungsten inert-gas welding, molten metal and electrode are protected by inert gas. Wire filler metal is fed from a reel through a torch. Feed rate and currents are high and welding is done rapidly. CO_2 and CO_2-argon mixtures can be used as shielding.▼

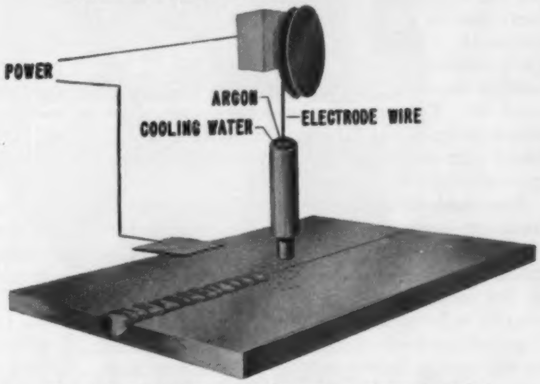

Fig. 5 Submerged-Arc Welding. The electrode is fed through the welding composition, or flux, which is added through a tube preceding the electrode. The arc occurs below the surface of the welding composition. High wire feeds and high amperages combine to provide high welding speeds.▼

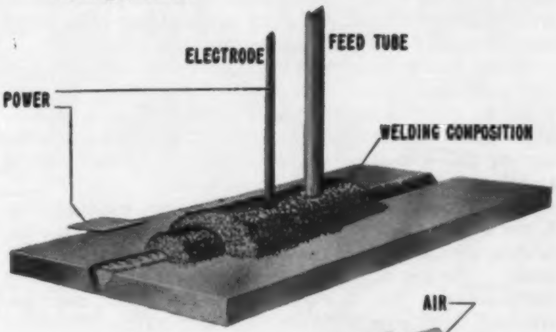

Fig. 6 Compressed-Air Carbon-Arc Cutting. "Arc-Air" cutting equipment consists of an electrode holder which grips a carbon electrode between jaws having orifices arranged in them so that streams of air are directed to blast out the molten metal under the carbon-arc flame

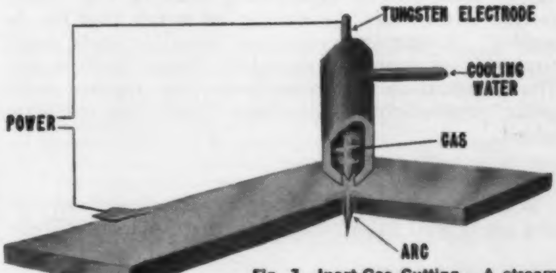

Fig. 7 Inert-Gas Cutting. A stream of gas, usually a hydrogen-argon mixture, passes through an orifice through which an arc is also maintained between a tungsten electrode and the workpiece. Dissociation of the gases in the arc flame adds heat at between 27,000 and 30,000 F.

The nozzle is held against the material, and upon pressing the trigger the flow of cooling water to the torch and inert gas for shielding the arc are started and the arc is initiated. During the automatically controlled welding cycle, which usually requires less than 2 sec, a pool of molten metal forms, fusing with the metal in contact with it. This technique is very attractive in maintenance sheet-metal fabrication because of its versatility. Most commercial metals, other than aluminum, can be spot-welded by this method.

Consumable-Electrode Inert-Gas-Shielded Welding. As in tungsten inert-gas welding, the molten metal and the electrode are protected by inert gas in consumable-electrode inert-gas-shielded welding, Fig. 4. Filler metal in the form of wire is fed from a reel through a torch, usually referred to as a "gun." Wire available in $^{3}/_{64}$ to $^{3}/_{32}$-in-diam feeds through the gun at rates as high as 300 to 400 ipm at currents up to 500 amp or more. Deposit rates are high and consequently the welding operation is very rapid. Much work has been done in the modification of power sources to provide characteristics which will permit the use of CO_2 as a shielding gas, which reduces welding costs considerably. Carbon steels can be welded using CO_2 as a shielding gas, and low-alloy steels may be welded using CO_2-argon mixtures.

Where maintenance work includes the fabrication or repair of heavy-plate weldments and facilities are provided to position such work, this method will produce high-quality welds economically. It is also suitable for carbon and low-alloy steels, aluminum, copper alloys, stainless steel, nickel, and nickel alloys.

Submerged-Arc Welding. In submerged-arc welding, Fig. 5, the electrode is fed through the welding composition, or flux, which is added through a tube preceding the electrode. The arc occurs below the surface of the welding composition. As in consumable-electrode inert-gas welding, high wire feeds and high amperages combine to provide high welding speeds. The method is particularly suitable for heavy plate thicknesses in carbon steel and has been used with success to build up surfaces of rolls and shafting.

Consumable-Electrode Welding With Midget Guns. A number of small guns for consumable-electrode inert-gas welding have recently been placed on the market. Wire as small as 0.020 in. diam can be handled, with the advantage that weld pools are smaller and more easily controlled. Welding may be performed not only on light-gage materials at high welding speeds, but in the vertical and overhead positions on any thickness material with speeds considerably greater than for other manual methods. Depending on metal and power characteristics, CO_2 or CO_2-argon mixtures may be used for some applications, while argon is used for others. To date, the difficulties associated with drawing some of the "hard-metal" wires limit the number of metals that can be welded. Aluminum, carbon and low-alloy steels, stainless steel, and copper are among the present applications. The potential in maintenance welding appears to be great, particularly as additional "hard" materials are added.

Thermal Cutting

Both manual and mechanized oxyacetylene flame cutting are so well known that a lengthy explanation is not required. The speed and quality of cuts are excellent, but are limited to carbon steel.

Iron-Powder Cutting. To cut metals other than steel, a method known as iron-powder cutting was introduced shortly after World War II. An auxiliary nozzle causes streams of iron powder, propelled by dry air or nitrogen, to converge in the oxygen stream of the main nozzle. The heat liberated by the burning iron powder is sufficiently high to melt and wash away oxides and metal, and most metals may be cut at speeds and with a kerf not unlike carbon steel. There is a heavier slag and powder residue, and a contamination of the metal adjacent to the cut surface for a depth up to approximately $^{1}/_{16}$ in. For many purposes the contaminated metal must be machined or ground off prior to subsequent fabricating operations. Even so, powder cutting offers a fast and economic method of cutting alloys and nonferrous metals.

Compressed-Air Carbon-Arc Cutting. "Arc-Air" cutting, Fig. 6, is suitable for use on all commercial metals, and is a versatile tool in maintenance work. An electrode holder grips a carbon electrode between jaws in which orifices are arranged to direct streams of air for blasting out the molten metal under the carbon-arc flame.

For gouging out or making grooves in plate, for making cuts where irregularities are not objectionable, or for removing defective welds, this method is most useful. This is a grooving or gouging tool rather than a cutting tool, and it should be remembered that cutting of heavy material can only be accomplished through a number of passes or gouges. Each of these increases the depth of the cut by approximately $^{1}/_{4}$ in. The gouge would be about $^{1}/_{8}$ to $^{3}/_{4}$ in. wide. There is some carbon pickup adjacent to the cut surface which varies from a few thousandths in heavy thickness to 0.040 in. or so in lighter gages. While this is of no consequence in carbon steel, removal of this material by machining or grinding may be required in such materials as stainless steel.

Inert-Gas Cutting. One of the most spectacular techniques to be developed in recent years is inert-gas cutting, Fig. 7. A stream of gas, usually a hydrogen-argon mixture, passes through an orifice through which an arc is also maintained between a tungsten electrode and the work.

Dissociation of the gases in the arc flame liberates additional heat—between 27,000 and 30,000 F. The expansion of the gases causes them to flow from the orifice at near-sonic velocities. All metals may be cut with this process. Cutting speeds for most metals are on the order of those for the oxyacetylene cutting of carbon steel of similar thickness, but aluminum is cut at speeds as high as 350 ft per hr for $^{1}/_{2}$-in. plate. Cuts are clean and of high quality. The dross (slag) is easily removed. There is no contamination of base metal.

Summary

Many of the welding methods introduced in industry to meet the specific needs of metals fabrication have application in maintenance welding. For economy and reliability in plant-maintenance work, those methods should include oxyacetylene, metal-arc, nonconsumable-electrode inert-gas-shielded welding, and consumable-electrode inert-gas-shielded welding especially with midget guns, and, to a limited extent, submerged-arc welding. For thermal cutting, in addition to the oxyacetylene method for steel, methods for alloys and nonferrous metals are needed. These would include carbon-arc air gouging, inert-gas cutting, or, in lieu of the inert-gas method, iron-powder cutting.

It is the purpose of this review to appraise the important new knowledge on metalworking appearing in published literature in the past year, and to help improve metalworking practices in industry

ANNUAL REVIEW

A REVIEW OF Metal-Processing Literature[1]

GRINDING

PLASTIC WORKING

CUTTING FLUIDS

METAL CUTTING

[1] Based on four papers contributed by the Production Engineering Division and presented at the Production Engineering Conference, Milwaukee, Wis., May 17–19, 1960, of The American Society of Mechanical Engineers.

The members of the Literature Review Committee of the Metal Processing Research Activity of ASME are:

E. G. Thomsen, University of California—Metal Cutting Analysis.
F. W. Boulger, Battelle Memorial Institute—Plastic Working of Metals.
G. S. Reichenbach, Massachusetts Institute of Technology—Grinding.
P. A. Smith, Massachusetts Institute of Technology—Cutting Fluids.
K. H. Moltrecht, Cornell University—Metal Cutting Practice.
W. Pentland, Cincinnati Milling Machine Company—Chairman.

METAL CUTTING[2]

By J. S. Campbell,[3] S. Kobayashi,[4] J. M. Galimberti,[5] R. S. Hahn,[6] and E. G. Thomsen[7]

The year 1959 provides us with a wealth of papers dealing with metal cutting. Some 75 papers were chosen for review and those deemed pertinent to metal-cutting analysis by the committee are included in this report. The papers which appeared in the 1958 [1][8] review as unpublished papers but have since been published will be given only brief attention.

Chip Formation

Chip formation in metal cutting continued to hold interest. Takeyama and Usui [2] carried out shear tests on aluminum, copper, brass, mild steel, and alloy steel in a special shear-test apparatus. Christopherson, et al. [3], from experimental observations conclude that the rigid-plastic hypothesis applied to the chip is erroneous and that the material in the chip should be regarded as a real isotropic work-hardening metal. Carro-Cao [4] uses the concept that continuous chips are in reality not continuous and should be examined in the light of a periodic process.

Lamm [5] proposes a hydrodynamic theory for the metal in the chip which, under the authors' concepts, undergoes a deformation process analogous to that in a cylinder during the squeezing action of an upsetting process. Walker [6] reports that beryllium chips show little plastic deformation and are of the discontinuous type. Niedzwiedzki [7] discusses the well-known phenomenon of the discontinuance of the cutting action when the undeformed chip thickness drops below a certain minimum value.

Mechanics of Metal Cutting

Several papers dealt with the shear problem and associated phenomena. Kobayashi and Thomsen [8] and Kobayashi, et al. [9] have shown that the shearing stress on the shearing plane appears to be constant over a wide range of speeds, rake angles, and feeds for a variety of metals including several steels, aluminum alloys, and brass. Gideon, Simon, and Grover [10] discussed the shear-angle relationship and the lack of agreement between experiment and theory. Eggleston, Herzog, and Thomsen [11], and Kobayashi, et al. [9], also conclude from their experimental observations that, until now, no completely satisfactory criterion has been advanced for the functional relationship of the rake, shear, and friction angles. McDonald and Murphey [12] suggest that the deviation between the Merchant minimum-energy shear angle and experimentally determined shear angle may be related to the strain induced in the chip. Roehlke [13] considers the mechanism of metal cutting and comes to the conclusion that the flank-surface forces may not be negligible in comparison with the other forces. Ling and Saibel [14] have analyzed the specific work of deformation in the workpiece under the tool.

Trigger and Chao [15] reduced the tool-chip contact areas artificially and found some remarkable decrease in power consumption, increase in tool life, and other benefits as compared with cutting tests carried out with natural contact lengths. They also found that an optimum contact length exists for best cutting conditions. Kobayashi and Thomsen [16] also made controlled tool-chip contact length studies as well as artificial flank-wear-land studies. These investigators found that the friction mechanism apparently due to welding of sufficient junctions causes sticking of the metal which leads to sublayer bulk flow. Shaw, et al. [17], also reported sublayer deformation, similar to that encountered in metal cutting, with friction studies of a modified Brinnell-type friction tester. Usui and Takeyama [18] performed a novel experiment by using a tool which was made of a photoelastic material and subjecting it to cutting tests with lead. Finally, Albrecht [19] reinvestigated the tool forces and suggests also that the normal tool forces are not uniformly distributed over the tool face.

Tool Life and Tool Wear

The large number of papers dealing with tool life and wear shows the current interest that these subjects hold. Hehenkamp [20] explores the effect of insulation and application of a compensating voltage on wear of carbide tools. Dorinson [21] derives a tool-wear equation. The initiation of wear is postulated as a temperature-dependent migration of chip metal into the tool. The effects are used to explain the behavior of the Taylor equation. Olberts [22] studied flank wear on tool-chip interface temperature. He found the relationship that the chip-thickness ratio decreased with increasing wear land and that sharp tools yielded higher interface temperatures than when wear lands of about 0.010 in. were present.

Peckner and Ginsburg [23] applied a statistical analysis to wear data for the selection of form cutters. Trent [24] studied worn cemented-carbide tools in order to determine the factors affecting wear, built-up edge, cratering, cracking of cutting edge, and others. Shaw [25] discussed recent German metal-cutting investigations on tool life and wear and reports that important advances are being made there. Krekeler [26] analyzed the behavior of cast milling cutters and found that they compare favorably with forged tools. Tschirf and Eder [27] investigated tool life in turning under varying cutting conditions, while Colding [28] develops a tool-life equation for the three variables: cutting speed, chip equivalence, and tool life. Weber [29] studied tool life for plain carbon (0.1-0.6 per cent C) and alloy steels and found that tool life for carbon steels is lower than that for the alloy steels.

Clouse and Hall [30] developed an equation for optimum drilling speed from drilling torque tests determined from the drilling of a few holes. Gulyaev, et al. [31]

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[2] Condensed from ASME Paper No. 60—Prod-12.

[3] Associate Professor of Industrial Engineering, University of California, Berkeley, Calif.

[4] Lecturer in Mechanical Engineering, University of California, Berkeley, Calif.

[5] Project Engineer, Metal Cutting Division, Kennametal, Inc., Latrobe, Pa. Assoc. Mem. ASME.

[6] Research Engineer, The Heald Machine Company, Worcester, Mass. Mem. ASME.

[7] Professor of Metal Processing, University of California, Berkeley, Calif. Mem. ASME.

[8] Numbers in brackets designate References at end of paper.

oxidized high-speed steel tools by a steam treatment at 500-600 C and found that in drilling tests the oxidized drills showed from 130 to 165 per cent greater durability. The tool life of cemented-boride tools was investigated by Brewer [32] who found these tools weak but displaying possibilities for tool materials.

Machinability

The general area of machinability is covered by Boulger [33, 34] who discussed the influence of metallurgical properties on machining operations and summarized the present knowledge of the various factors affecting machinability. Shaw and Smith [35] discussed the results from tests on the workpiece compatibility of ceramic tools, which is defined as the relative ability of a given tool to perform well when cutting a given workpiece. Opitz [36] gave a general background on the performance and manufacture of ceramic tools and discussed the cause of wear and other factors connected with machinability. Moore and Lord [37] discussed the effect of some major constituents in gray iron on the machinability of this material. Maranchik, Gould, and Arzt [38] presented extensive test results on turning, milling, drilling, and tapping operations of ultra-high-strength thermal-resistant alloys. The data include tool life data with carbide and high-speed tools. Schmidt [39] discussed high-speed machining, hot-machining, and other newer machining processes and stresses importance of theoretical studies. Finally, Merchant [40] in a most provocative article looks into the future and attempts to predict what might be expected in advances in machining processes in 1970.

Newer Machining Processes

Some of the newer machining processes no longer involve removal of stock in the form of chips and hence the name "metal cutting" may no longer be a descriptive name. Because of their importance, however, and for lack of another subdivision, this review will include some of the important papers published in this area during the past year.

Zingerman [41] presented some of the basic theory involved in spark-machining. Schulz [42] described both theory and practical applications of electro-erosion machining processes. Ruediger and Winkelmann [43] also presented the theory of electro-erosion machining processes and discussed such factors as rate-of-removal of metal, accuracy, surface quality, and others. McDowell and Lascoe [44] compared the metal-removal rate for five types of electrodes used in electro-spark machining of 0.865-in. holes in $^1/_2$-in. plate. Matsuyama and Kayaba [45] also gave a theory of spark machining and gave experimental data for consumption of electrodes, effect of clearance, rate of removal, and others. Berg [46] described a new electron-beam method of obtaining very small holes. This process eliminates the cutting tool, but the author presents no analysis. Froment [47] applied the law of Faraday to a study of the anodic dissolution of metals in electrolytic polishing. Rosenberg and Iakimovich [48] gave experimental results on ultrasonic machining of eleven hard materials.

Vibration

The following papers dealt with vibration problems: Hammond [49] discussed the general principle of vibration insulation of machinery in general, but gave little on machine tools. Cook [50] discussed instability in metal cutting which induces self-excited vibrations. Frommelt [51] gave experimental results of vibration studies with powdered-iron tool holders.

References

1 J. M. Galimberti, R. S. Hahn, H. J. Siekmann, and E. G. Thomsen, "A Review of Metal-Processing Literature," Mechanical Engineering, vol. 81, Sept., 1959, pp. 57–60.

2 H. Takeyama and E. Usui, "Study of Machinability of Metals," *Journal of Engineering for Industry, Trans. ASME*, vol. 81, Series B, November, 1959, p. 289.

3 D. G. Christopherson, P. L. B. Oxley, W. B. Palmer, "Orthogonal Cutting of Work-Hardening Material," *Engineering*, vol. 186, July 25, 1958, pp. 113–115.

4 G. Carro-Cao, "Study of Chip Formation: Problem of Plastic Deformation as Deduced From Theory of Discontinuous Chip Removal," *Microtecnic*, vol. 12, Dec., 1958, pp. 331–337.

5 M. M. Lamm, "Chip Formation in Metal Cutting," *Engineering*, vol. 187, April 3, 1959, pp. 444–446.

6 D. R. Walker, "Beryllium Machining Characteristics," Mechanical Engineering, vol. 80, Aug., 1958, pp. 57–62.

7 A. Niedzwiedzki, "Hard Spots in Machined Surface," *Tooling and Production*, vol. 24, March, 1959, pp. 57–59.

8 S. Kobayashi and E. G. Thomsen, "Some Observations on Shearing Process in Metal Cutting," *Journal of Engineering for Industry, Trans. ASME*, vol. 81, Series B, 1959, pp. 251–262.

9 S. Kobayashi, R. P. Herzog, D. M. Eggleston, E. G. Thomsen, "A Critical Comparison of Metal-Cutting Theories With New Experimental Data," ASME Paper No. 59—A-131.

10 D. Gideon, R. Simon, H. Grover, "Mechanism of Chip Formation," American Society of Tool Engineers—Res. Rep. no. 9, paper no. 75, May 1, 1958, p. 8.

11 D. M. Eggleston, R. Herzog, E. G. Thomsen, "Observations on the Angle Relationships in Metal Cutting," *Journal of Engineering for Industry, Trans. ASME*, vol. 81, Series B, August, 1959, pp. 263–279.

12 W. J. McDonald and B. F. Murphey, "The Deformation Process in Metal-Cutting," ASME Paper No. 59—A-165.

13 G. Roehlke, "Zur Mechanik des Zerspanvorganges," *Werkstatt und Betrieb*, vol. 91, no. 8, August, 1958, pp. 473–483.

14 F. F. Ling and E. Saibel, "On Criterion of Cutting Velocity in Metal Machining," *American Society of Lubrication Engineers, Trans.*, vol. 1, April, 1958, pp. 124–129; discussion, pp. 129–130.

15 B. T. Chao and K. J. Trigger, "Controlled Contact Cutting Tools," *Journal of Engineering for Industry, Trans. ASME*, vol. 81, Series B, May, 1959, pp. 139–151.

16 S. Kobayashi and E. G. Thomsen, "The Role of Friction in Metal Cutting," ASME Paper No. 59—A-132.

17 M. C. Shaw, A. Ber, P. A. Mamin, "Friction Characteristics of Sliding Surfaces Undergoing Subsurface Plastic Flow," privately printed, Mass. Inst. of Tech., 1959, p. 5.

18 E. Usui and H. Takeyama, "Photo-Elastic Analysis of Machining Stresses on Rake Face," Tokyo, *Govt. Mech. Lab. J. Mech. Laboratory*, (English ed.), vol. 4, no. 1, 1958, pp. 6–14.

19 P. Albrecht, "New Developments in the Theory of the Metal-Cutting Process," ASME Paper No. 59—A-243.

20 T. Hehenkamp, "Untersuchungen ueber den elektrisch kompensierbaren Verschleiss an Drehmisseln aus Hartmetallen," *Archiv für das Eisenhuettenwesen*, vol. 29, no. 4, April, 1958, pp. 249–256.

21 A. Dorinson, "Theory of Cutting-Tool Wear and Cutting-Oil Action," *Amer. Soc. Lubr. Engrs., Trans.* vol. 1, April, 1958, pp.131–138.

22 D. R. Olberts, "Study of Effects of Tool Flank Wear on Tool Chip Interface Temperature," *Journal of Engineering for Industry, Trans. ASME*, vol. 81, Series B, May, 1959, pp. 152–158.

23 D. Peckner and H. Ginsburg, "Evaluating Tool Life," *Tool Engineer*, vol. 42, March, 1959, pp. 75–79.

24 E. M. Trent, "Tool Wear and Machinability," *Journal, Institution of Production Engineers*, vol. 38, March, 1959, pp. 105–130.

25 M. C. Shaw, "Some Recent European Metal-Cutting Investigations," ASTE Technical paper, vol. 53, no. 12, 1958, p. 14.

26 K. A. Krekeler. "Leistung von gegossenen und warm verformten Werkzeugen aus Schnellarbeitsstahl und ihre metallurgischen Grundlagen," *Stahl und Eisen*, vol. 78, Oct. 30, 1958, pp. 1575–1585.

27 L. Tschirf and E. Eder, "Standzeit eines Drehmeissels bei veranderlicher Beanspruchung," *Werkstattstechnik und Maschinenbau*, vol. 48, April, 1958, pp. 193–198.

28 B. N. Colding, "Three-Dimensional, Tool-Life Equation—Machining Economics," *Journal of Engineering for Industry, Trans. ASME*, vol. 81, Series B, Aug., 1959, p. 11.

29 G. Weber, "Neuere Untersuchungen ueber den Zusammenhang zwischen der Spanentstehung und dem Standzeitverhalten beim Drehen von Stahl mit Hartmetall-Legierungen," *Stahl und Eisen*, vol. 78, Nov. 13, 1958, pp. 1678–1689; discussion, 1689–1690.

Metal-Processing Literature

ANNUAL REVIEW

30 R. D. Clouse and E. R. Hall, "Machinability or Cutting Fluid Evaluation by Drilling Torque Test," *Lubrication Engineer*, vol. 14, Nov., 1958, pp. 483–487.

31 A. P. Gulyaev, Z. S. Luneva, G. G. Korolev, V. V. Samoilov, "Termicheskaya Obragotka instrumentov iz bystrorezhushchei stali v atmosfere para," *Metallovedenie i Obrabotka Metallov*, Nov., 1958, pp. 39–44.

32 R. C. Brewer, "Cemented Borides as Tool Materials," *Engineers Digest*, vol. 20, May, 1959, pp. 205–208.

33 F. W. Boulger, "What Is Known Today About Metal Cutting," ASTE Research Fund, no. 14, paper no. 44, May 1, 1958, p. 9.

34 F. W. Boulger, "Influence of Metallurgical Properties on Metal-Cutting Operations," ASTE Research Report, no. 12, paper no. 80, May 1, 1958, p. 19.

35 M. C. Shaw and P. A. Smith, "Workpiece Compatibility of Ceramic Cutting Tools," *American Society of Lubrication Engineers, Trans.*, vol. 1, no. 2 (Lubrication Science and Technology), 1958, pp. 336–344.

36 H. Opitz, "Applications of Ceramic Cutting Materials and Causes of Wear of Hard Metal Tools," *Microtecnic*, vol. 12, Oct., 1958, pp. 267–288.

37 W. W. Moore and J. O. Lord, "Gray Cast Iron Machinability, Quantitative Measurements of Pearlite and Graphite Effects," *Modern Castings*, vol. 35, April, 1959, pp. 55–60.

38 J. Maranchik, Jr., J. V. Gould, P. R. Arzt, "Machining of Ultra Strength Alloys," SAE-Paper no. 43R for meeting March 31–April 3, 1959, p. 40.

39 A. O. Schmidt, "Ultrahigh-Speed Machining—Panacea or Pipedream?" *Tool Engineer*, vol. 41, November, 1958, pp. 105–109.

40 M. E. Merchant, "10 Years Ahead—What's in It for Metalworking," *American Machinist*, vol. 103, May 18, 1959, pp. 142–146.

41 A. S. Zingerman, "Electro-Erosional Properties of Metals," *Physics of Metals and Metallography* (translation of Fizika Metallov i Metallovedenie), vol. 5, 1957, pp. 45–51.

42 H. J. Schulz, "Die Werkzeugherstellung mit Funkenerosionmaschinen," *Giesserei*, vol. 45, Sept. 25, 1958, pp. 615–623.

43 O. Ruediger and A. Winkelmann, "Ueber die elektroerosive Metallbearbeitung," *Metall.*, vol. 12, May, 1958, pp. 366–380.

44 R. W. McDowell and O. D. Lascoe, "What's Best Electrode Shape for Removing Metal?" *American Machinist*, vol. 103, April 20, 1959, pp. 133–135.

45 T. Matsuyama and T. Kayaba, "Study on Electro-Spark Machining by Alternating Current," *Japan Society of Mechanical Engineers, Bulletin*, vol. 2, Feb., 1959, pp. 86–91.

46 R. R. Berg, "Electron Beam Machining," *American Machinist*, vol. 103, March 9, 1959, pp. 115–116.

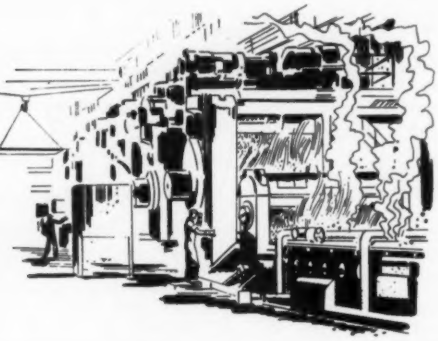
47 M. Froment, "Sur l'application de la loi de Faraday a l'etude de la dissolution anodique des metaux," *Corrosion et Anticorrosion*, vol. 6, Nov., 1958, pp. 412–420, vol. 7; Jan., 1958, pp. 13–19; Feb., p. 46–55; March, pp. 98–169; April, pp. 134–145.

48 L. D. Rosenberg and D. F. Iakimovich, "Ultrasonic Machining of Hard and Brittle Materials," *Engineers Digest*, vol. 20, June, 1959, pp. 255–256.

49 R. Hammond, "Vibration Insulation and Its Problems," *Insulation* (London), vol. 2, Jan.-Feb., 1958, pp. 40–42; March–April, pp. 99, 101, 103; July–Aug., pp. 205–208; Sept.–Oct., pp. 256–259.

50 N. H. Cook, "Self-Excited Vibrations in Metal Cutting," *Journal of Engineering for Industry, Trans. ASME*, vol. 81, Series B, May, 1959, pp. 183–186.

51 H. A. Frommelt, "Cut 75 Per Cent Faster With Powder Metal Shanks," *Tool Engineer*, vol. 42, May, 1959, pp. 55–57.



PLASTIC WORKING[9]

By Francis W. Boulger[10]

Many recent investigations have narrowed the gap between the science and art of plastic working. Fortunately, the analytical and experimental effort is being directed toward a variety of metal-forming processes.

Rolling

MacGregor and Palme [1] reported the contact normal pressures developed in rolling square bars of aluminum, copper, and steel under various conditions. They developed a method for calculating torques and loads and explained why the pressure distributions are different for bars than for strips.

A refined analysis of the mechanics of strip rolling was presented by Jortner, Osterle, and Zorowski [2]. Their analysis uses the maximum shear-strain energy criterion for yielding and adapts Orowan's theory to noncircular contact arcs noted experimentally. This and other work [9] suggest that rolling theories are quantitatively precise. Tselikov believes this is also true of his equation [3]. Probably the main need in this field is for more accurate determintions of friction coefficients [2, 3] and for accumulating or examining accurate experimental data [4].

Forging

The forging theory, based on a simplified state of stress advanced by Kobayashi, Thomsen, and associates [5, 6, 7] fits their experimental data quite well. Their studies were concerned with producing a finished forging from a preblocked shape. They assume that, in this case, all of the plastic deformation is restricted to the flash and the metal from which it comes [5]. Thus the finishing operation can be considered as the deformation of a "fictitious disk" having a thickness corresponding to the instantaneous height of the flash under conditions of variable surface friction.

Kobayashi, Herzog, Lapsley, and Thomsen [6] found that their theory predicted average forging loads close to experimental values. The forging loads were calculated from instantaneous flow strengths determined in separate compressive tests at suitable strain rates.

[9] Condensed from ASME Paper No. 60—Prod-13.

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Kobayashi and Thomsen [5] determined experimentally the velocity vectors in the flash and body of a lead forging having axial symmetry. MacDonald, et al. [7], reported on a later phase of the study in which forgings were made with overhanging flash with and without restricted flash lands. Measurements indicated that plastic flow tends to equalize the pressure within the body of a forging.

Stankovic experimented with a forging machine which superimposed several blows of short duration on a gradually increasing forging force [8].

Contractor and Morgan [10] summarized the information available on the effect of chemical composition on the performance of steels in hot-twist tests. According to Wallquist and Carlen [11], this type of test measures one of the factors affecting forgeability.

Extrusion

Wilcox and Whitton [12] derived a formula correlating the pressure required for inverted extrusion with die angle and extrusion ratio. Data were obtained on high-purity aluminum over a wide range of conditions.

Johnson extended prior theory, based on plane strain in wedge-shaped dies, to convex, concave, and bell-mouthed dies [13]. His methods should help designers concerned with estimating loads for extrusion, coining, and drawing. Johnson's analysis also explains the "sucking" defect on the outer surface of tubes or pins formed by double piercing [14].

Sheet-Metal Working

A study on blanking of transformer steel, by Wukusick and Zeno [15], showed that die wear was less for normalized than for annealed sheet. Wear rates also varied with blank orientation.

Datsko and Yang [16] developed a simple equation for predicting the minimum bend radii of sheet materials from their reduction of area values in tensile tests. Stewart [17] pointed out that mathematical methods for predicting formability are useful but some scrap is attributable to quality variations among sheets.

Considerable developmental effort is being applied to techniques for warm-working sheet metals [18, 19, 20]. DeGroat [21] describes some of the practices used for forming titanium alloys at 1100 F. Axtell [22] recommends deep drawing hot-rolled magnesium alloys at 350 F, at a rate fast enough to avoid annealing, to obtain parts with superior denting resistance.

The problem of evaluating drawing quality by laboratory tests continued to attract attention [22–27]. Kokkonen and Nygren [23] studied the reproducibility of cup-drawing tests, stretch-forming tests, and Erichsen values. Their studies show the influence of surface roughness and punch radius on performance in the latter two test methods. Krisch, Muhr, and Schlueter [24] reported on a co-operative study on 20 steels by four laboratories using a cup-drawing test.

Since drawing operations deform metals by both tensile and compressive stresses, Guyot and Mercier [25] built a special apparatus to evaluate the response of sheets in compression. Their tests on wedge-shaped specimens of copper, brass, aluminum, and various steels rated the materials in a different order than tensile elongation and Erichsen values.

R. L. Whiteley [26] demonstrated that a strong, direct correlation exists between drawing quality of sheet steel, as measured by the Swift cup-drawing test, and the corresponding ratios of width-to-thickness strains in tensile tests.

Miscellaneous Production Developments

The growing need for components suitable for operation at temperatures over 1500 F has stimulated research on methods of fabricating refractory metals. Bruckart [28] published a good summary of the current state of the art on processing such materials.

The development and installation of large, versatile equipment for spinning-forging operations constitute a significant advance in the art of metalworking. Several articles describing such processes under equipment trade names have appeared [29, 30, 31]. In general, the machines combine the principles of spinning and roll-forming in a single operation. Prototype work indicates that waffle patterns and rib-wall thickness ratios up to 15 can be produced with some machines.

The applications of exceedingly fast strain rates in metal-forming operations are being investigated. Pneumatic systems, magnetic fields, electric-spark discharges in liquid media, and various explosives have been used as energy sources. Explosives have been used in a number of small-lot production operations. Although a considerable amount of engineering information on metalworking with explosives has been published [32–35], scientific knowledge of the subject is still meager.

References

1 C. W. MacGregor and R. B. Palme, "Distribution of Contact Pressures in Rolling Metals," *Journal of Basic Engineering, Trans. ASME*, vol. 81, Series D, pp. 669–680.

2 D. Jortner, J. F. Osterle, and C. F. Zorowski, "Analysis of Mechanics of Cold Strip Rolling," *Iron and Steel Engineer*, vol. 36, May, 1959, pp. 127–133.

3 A. I. Tselikov, "Souremennoe sostoganie teorii davleniya metalla no valki pri prodol'noi prokatke," *STAL*, vol. 18, May, 1958, pp. 434–441.

4 Yu M. Chizhikov, "Kraschetu davleniya metalla no volki," *STAL*, vol. 18, May, 1958, pp. 428–433.

5 S. Kobayashi and E. G. Thomsen, "Approximate Solutions to a Problem of Press Forging," *Journal of Engineering for Industry, Trans. ASME*, vol. 81, Series B, Aug., 1959, pp. 217–227.

6 S. Kobayashi, R. Herzog, J. T. Lapsley, Jr. and E. G. Thomsen, "Theory and Experiment of Press Forging Axisymmetric Parts of Aluminum and Lead," *Journal of Engineering for Industry, Trans. ASME*, vol. 81, Series B, Aug., 1959, pp. 228–238.

7 A. G. MacDonald, S. Kobayashi, and E. G. Thomsen, "Some Problems of Press Forging Lead and Aluminum," ASME Paper No. 59—A-164.

8 P. Stankovic, "Static-Dynamic Forging; Principles and Some Characteristics," *Metal Treatment and Drop Forging*, vol. 25, Dec., 1958, pp. 489–494.

9 A. Methea, "Nomogramme zur Ermittlung vin Walzkraeften auf Grund der Gleichung von S. Ekelund," *Stahl and Eisen*, vol. 78, Oct. 2, 1958, pp. 1383–1389.

10 G. P. Contractor and W. A. Morgan, "Critical Survey of Literature on Forgeability of Steels," *Metal Treatment and Drop Forging*, vol. 26, Feb., 1959, pp. 65–71.

11 G. Wallquist and J. C. Carlen, "Hot Twist Tests for Evaluating Forgeability of Steel," *Jerkontorets Annaler*, vol. 143, no. 1, 1959, pp. 1–28.

12 R. J. Wilcox and P. W. Whitton, "Cold Extrusion of Metals Using Lubrication at Slow Speeds," *Institute of Metals Journal*, vol. 87, pt. 9, May, 1959, pp. 289–293.

13 W. Johnson, "Upper Bound Loads for Extrusion Through Circular Dies," *Applied Science Research*, Section A, vol. 7, no. 6, 1958, pp. 437–448.

14 W. Johnson, "Elementary Consideration of Some Extrusion Defects," *Applied Science Research*, Section A, vol. 8, no. 1, 1958, pp. 52–60.

15 C. S. Wukusick and R. S. Zeno, "Improving Punchability of Silicon Steel," *Tool Engineer*, vol. 41, Dec., 1958, pp. 63–70.

16 J. Datsko and C. T. Yang, "Correlation of Bendability of Materials With Their Tensile Properties," ASME Paper No. 59—A-110.

17 D. A. Stewart, "How to Evaluate Formability of Sheet Metals," *Materials in Design Engineering*, vol. 48, Dec., 1958, pp. 100–102.

Metal-Processing Literature

ANNUAL REVIEW

18 J. E. Hagins, "Norair Heats Work Within Seconds for High-Temperature Forming," *Machinery*, vol. 65, July, 1959, pp. 118–121.

19 R. H. Stevens, "Forming Titanium on Contract Production Basis," *Western Machinery and Steel World*, vol. 49, Dec., 1958, pp. 50–52.

20 J. Soja, "Reduction of Warpage by Creep Forming and Die Quenching of Nonferrous Alloys," *Metal Process*, vol. 76, Aug., 1959, pp. 77–80.

21 G. H. DeGroat, "Heat and Speed Form Latest Titanium Alloys," *American Machinist*, vol. 103, July 27, 1959, pp. 108–111.

22 W. G. Axtell, "Formed Magnesium Parts Can Keep Rolled Strength," *Materials in Design Engineering*, vol. 50, Sept., 1959, pp. 92–93.

23 V. Kokkonen and G. Nygren, "Investigations Into the Accuracy of Erichsen Cupping Test," Jernkontorets Annalev, vol. 142, no. 10, 1958, pp. 638–660.

24 A. Krisch, K. H. Muhr, and W. Schlueter, "Zur Blechpruefung mit dem Naepfchenziehversuch," *Archiv fur das Eisenhuettenwesen*, vol. 29, no. 5, May, 1958, pp. 313–320.

25 J. Guyot and P. Mercier, "La rétreinte dans l'emboutissage," *Revue de Metallurgie*, vol. 55, Aug., 1958, pp. 801–814.

26 R. L. Whiteley, "The Importance of Directionality in Drawing Quality Sheet Steel," American Society for Metals, Preprint No. 174, 1959.

27 C. R. Vassel, "Some Investigations Into Fundamental Characteristics of, and Some Simulative Tests for, Aluminum Sheets for Deep Drawing," *Sheet Metal Industries*, vol. 36, Aug.–Sept., 1959, pp. 543–546, 556.

28 W. L. Bruckart, "Fabrication of Refractory Metals," *Metal Industry*, Jan. 23, 1959, pp. 63–66; Jan. 30, pp. 83–86; Feb. 6, pp. 103–106; Feb. 13, pp. 123–125, 132.

29 A. W. Ernestus, "Roll Extrusion, A New Metal-Forming Technique," *American Machinist*, vol. 103, June 29, 1959, pp. 84–86.

30 R. G. Longley, "Chipless Turning, A Review of Principles and Scope of Flow Forming," *Welding and Metal Fabrication*, vol. 27, June, 1959, pp. 229–233.

31 "Machine Forms Giant Tubes in One Pass, Without Welding," *Iron Age*, vol. 184, July 16, 1959, pp. 99–101.

32 J. S. Rinehart, V. Philipchuk, and J. Pearson, "Why Explosive Forming Works," *Steel*, vol. 144, Jan. 19, 1959, pp. 62–65.

33 R. A. Cooley, G. H. DeGroat, J. Savitt, and T. A. Dickinson, "Explosive Forming, How It Works, What It Does," *American Machinist*, vol. 103, June, 1959, pp. 127–138.

34 H. Vensel, "Explosive Fabrication," *Metal Industry*, vol. 94, June 12, 1959, pp. 481–482.

35 H. P. Tardif, "Shape Fasten, Engrave, Test Materials With Explosives," *Materials in Design Engineering*, vol. 49, Feb., 1959, pp. 82–87.

CUTTING FLUIDS[11]

By P. A. Smith,[12] E. L. H. Bastian,[13] and C. A. Sluhan[14]

During 1959 there was a dearth of published research literature in the field of cutting-fluid research. Considerable work was conducted in this field, but apparently not published. A large portion of the published literature deals with "case history" stories, generalities, and so on, which are of economic importance to operating personnel but do not constitute contributions to the scientific understanding in the field.

Reaming Accuracy

Reaming is usually required to finish holes to close tolerances, but unfortunately in the past the results have been erratic. Ten Horn, Schurmann, and Slaats [1] show that since the reamer has a fixed size the variation is not due to the operator or tool. When different work-piece materials, steel, and cast tin bronze were reamed the sizes of the holes varied. The usual effect of the work-piece material is such that with steel the holes are produced oversize while with bronze undersized holes are produced.

Assuming the reamer to be properly ground and mounted, the variation was found to be due to variation in the built-up edge. When no built-up edge was present, this condition resulted in a hole smaller than the reamer. When a built-up edge was present, the hole was larger than the reamer. When no built-up edge was present, the finish was much smoother than that produced with a built-up edge. The built-up edge was controlled on steel with the use of trichloroethylene and also a chemical emulsion as cutting fluids and by cutting speed variation.

Cutting-Tool Wear Theory

A theory of cutting-tool wear was presented by Dorinson [2]. A tool-wear equation was derived from basic concepts of tool wear during metal cutting. Asperity, encounter, and wear as a function of cutting speed and temperature are considered as mechanisms of cutting-tool wear.

The chemical action of cutting-fluid additives was treated analytically. With certain additives there is a decrease in wear with increasing concentration of additive up to a certain level, beyond which further increase in additive concentration results in increased wear. The latter condition is attributed to the chemical action of the higher concentration of additive upon the tool.

Cutting Fluids at Low Speeds

Fluids used in metal cutting may be classified into

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those that are most useful at low speeds and act predominantly to improve surface finish and those that are most useful at high speeds and act predominantly as coolants. The low-speed materials function by reacting chemically with the chip to form a solid layer which prevents welding and metal transfer between chip and tool. A recent study of the action of low-speed fluids indicates that one of their requirements is the ability to produce a relatively high shear-strength layer.

According to Shaw [3] carbontetrachloride improves the cutting process at low speed which is not according to the previous American thoughts nor the current Russian opinions. Rather, it is stated the new explanation for the action of CCl_4 retains only the chemical reaction aspect of the present American picture and only the homogeneous strain aspect of the present Russian picture. The main actions resulting from the chemical reaction of CCl_4 vapor at the tool tip are:

1 The removal of the naturally occurring surface imperfections of varying size and the substitution of a greater number of uniform imperfections.

2 A primary increase in tool-face friction resulting from the presence of $FeCl_3$.

3 A large amount of secondary shear flow in the chip which gives rise to chip curl.

Carbontetrachloride appears to have a unique combination of properties that are ideally suited for cutting-fluid use. It is volatile, nonpolar, and its molecules are small, all of which will allow rapid and unhindered penetration to the fracture zone at the tool tip. Further, CCl_4 reacts readily with freshly cleaved steel to form a fracture surface that is relatively smooth and covered with a solid lubricant $FeCl_3$ that has relatively high shear strength.

The unusually good finish that is obtained when CCl_4 is used results from:

1 The absence of a built-up edge at the tool tip due to the presence of higher shear stresses which tend to sweep it away.

2 A burnishing action arising from the higher tool-tip stresses.

3 The chemical polishing action that is also responsible for the refinement of the fracture surface which in turn gives rise to more homogeneous straining and less strain-hardening.

It is to be expected that tool life is significantly reduced when CCl_4 is used as a cutting fluid.

References

1 "Reaming Accuracy Improved With Coolants," by B. L. ten Horn, R. A. Schurmann, and J. Slaats, *Tool Engineer*, vol. 42, March, 1959, pp. 93–99.

2 "Wear and Lubrication in Metal Cutting," by A. Dorinson, paper presented at Second Annual Spring Conference, ASME, Lubrication Division, March 16, 1959.

3 "On the Action of Metal Cutting Fluids at Low Speeds," by M. C. Shaw, *Wear* (printed in the Netherlands), vol. 2, Feb., 1959, pp. 217–227.

GRINDING [15]

By George Reichenbach [16]

During 1959 there was a surprising shift of interest in grinding problems from the previous year. The problems of chatter and residual stresses saw little new work, while investigations of surface structure and synthetic diamonds received considerable attention. Work on the important problems of chip formation and grinding-fluid action continued at a good pace.

Diamond Grinding

As synthetic diamonds became readily available at competitive prices, there was much interest in making comparisons with the natural product. A general review of the present position of synthetic diamonds was given in the *American Machinist* [1]. The principal difference noted is that the synthetic diamond is much more friable. Use of synthetic diamonds in a vitrified bond takes advantage of this friability. Nisula [2] also presents a good review of the advantages and disadvantages of the synthetic diamond.

Tarasov [3] investigated the economics of grinding high-alloy steels with diamond wheels. He found that in many cases it was cheaper to use diamond wheels than Al_2O_3 or SiC in spite of diamond's high cost. He cites actual G-ratios, wheel grades, and cost advantages.

Fanning [4] gives a general discussion of synthetic diamonds for grinding in general agreement with the previous papers. He also discusses the problem of standards for dressing diamonds.

There were two papers from England concerned with the mechanisms of diamond wear. The first, by Seal [5], notes that diamond abrasion is a special situation since there are no harder materials than diamonds available for polishing a diamond. He suggests that diamond wear is usually a thermal degradation of the surface to graphite.

The second paper by Bowden and Scott [6] looks at the wear of a diamond sliding on glass. The usual

[15] Condensed from ASME Paper No. 60—Prod-14.

[16] Assistant Professor of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, Mass. Assoc. Mem. ASME.

mechanisms of wear (mechanical abrasion, burning, or thermal graphitization) could not completely explain the results.

Surface Structure and Damage

Bowden and Scott [6] found that there were two types of surface damage and wear observed when sliding diamond on glass. Under mild sliding conditions the surface showed cracking and chipping; however, under more severe conditions there apparently was partial melting and flow of the glass forming a type of Beilby layer.

Rawstron [7] also studied the nature of polished glass surfaces and indicated the same two types of polishing action. Samuels and Sanders [8] studied polished silver surfaces. They made electron-diffraction studies and found no Beilby layer. There was a thin plastically deformed surface layer which for the finest surfaces showed crystallographic misorientations of only $\pm$ 5 deg. Samuels [9] also looked at industrially polished surfaces of the type produced by soft wheels charged with loose abrasive.

Grinding Mechanics

Krabacher [10] presents a good review of our present knowledge of the nature of grinding. He ties together many loose ends and is able to present a picture in many ways analogous to cutting tools. He shows how grinding-wheel wear is completely similar to tool wear. He relates the grinding variables to power, wheel wear, and surface finish. A new experimental technique for recovering partially formed grinding chips is presented.

Grinding Fluids and Chemistry

There is more and more understanding of the importance of the chemical interactions between abrasive, workpiece, and coolant evident in the literature this year.

Goepfert and Williams [11] made a detailed study of the reactions possible between the abrasives Al_2O_3 and SiC and various workpieces such as iron, titanium, and zirconium. These tests were at elevated temperatures.

Tarasov [12] studied the effect of sulfur additions to high-vanadium steels. The grinding ratio was increased 50–240 per cent by additions of 0.08 to 0.015 per cent sulfur. Gregor [13] looked into the chemistry of snagging wheels.

Dyer and Leggett [14] looked into the problem of surface contamination left by grinding affecting later operations requiring surface bonding.

Cadwell, Weisbecker, and McDonald [15] studied the grinding of titanium alloys with coated abrasives. They define a factor C for belt grinding which is equivalent to the K-factor (grinding ratio) for conventional wheel grinding.

Surface Stresses

Ball [16] reviews and correlates the work of Tarasov, Hyler, Letner, Sauvageot, Clorite, and Reed to make practical suggestions as to what variables should be chosen to get particular patterns of residual surface stresses.

Mueller [17] discusses some unpublished work of Letner that reports no difference between residual stress pattern left by up-grinding and down-grinding action of hardened steels.

Williams and Hammond [18] made an extensive study of surface preparation (shot-peening, grinding, chrome-plating, baking) on the fatigue life of high-strength steels. The work of Tarasov, Hyler, and Letner [19] just mentioned is an extensive experimental investigation of the effect of grinding conditions on fatigue life.

New Standards

Two new standards have been published by the American Standards Association. The first [20] presents a simplified set of shapes for dressing diamond holders. The second [21] gives a standard for identifying markings on various bonded abrasives with the exception of diamond wheels and special sharpening stones.

References

1 "Progress Report on Man-Made Diamonds," *American Machinist*, vol. 103, March 23, 1959, pp. 147–154.

2 "How Good Are Man-Made Diamonds?" by C. A. Nisula, *Grinding and Finishing*, vol. 4, Feb., 1959, pp. 22–26.

3 "Diamond Wheel Grinding of Tool Steels," by L. P. Tarasov, *Tool Engineer*, vol. 43, Oct., 1959.

4 "Effects of Recent Industrial-Diamond Developments," by C. L. Fanning, ASME Paper No. 58—A-180 for meeting Nov. 30–Dec. 5, 1958, 8 pp.

5 "Abrasion of Diamond," by M. Seal, *Proceedings of the Royal Society*, vol. 248, no. 1254, Nov. 25, 1958, pp. 379–393.

6 "Polishing, Surface Flow and Wear of Diamond and Glass," by F. P. Bowden and H. G. Scott, *Proceedings of the Royal Society*, vol. 248, Nov. 25, 1958, pp. 368–378.

7 "Nature of Polished Glass Surfaces," by G. O. Rawstron, *Journal of the Society of Technology*, vol. 42, Dec., 1958, pp. 253–260.

8 "Nature of Mechanically Polished Metal Surfaces: Electron-Diffraction Examination of Polished Silver Surfaces," by L. E. Samuels and J. V. Sanders, *Journal of the Institute of Metals*, vol. 87, pt. 5, Jan., 1959, pp. 129–135.

9 "Nature of Industrially Polished Metal Surfaces," by L. E. Samuels, *Journal of the Australian Institute of Metals*, vol. 4, May, 1959, pp. 1–11.

10 "Factors Influencing Performance of Grinding Wheels," by E. J. Krabacher, *Journal of Engineering for Industry, Trans. ASME*, vol. 81, Series B, Aug., 1959, pp. 187–200.

11 "Wear of Abrasives in Grinding," by G. J. Goepfert and J. L. Williams, Mechanical Engineering, vol. 81, April, 1959, pp. 69–73.

12 "Grinding Sulfurized Tool Steels," by L. P. Tarasov, *Tool Engineer*, vol. 42, Feb., 1959, pp. 77–80.

13 "Effects of Materials on Snagging Wheel Performance," by J. R. Gregor, *Grinding and Finishing*, vol. 4, Feb., 1959, pp. 28–31.

14 "Surfacing Zirconium Alloy Sheets With Abrasive Belts," by H. N. Dyer and R. A. Leggett, *Grinding and Finishing*, vol. 4, March, 1959, pp. 45–46.

15 "Grinding Titanium Alloy With Coated Abrasives," by D. E. Cadwell, H. L. Weisbecker, and W. J. McDonald, ASME Paper No. 58—SA-44 for meeting June 15–19, 1958, 9 pp.

16 "Controlling Grinding Stresses," by A. L. Ball, *Tool Engineer*, vol. 42, April, 1959, pp. 121–125.

17 "Residual Stresses Produced by Up Grinding and Down Grinding," by J. A. Mueller, *Grinding and Finishing*, vol. 4, Jan., 1959, pp. 30–33.

18 "The Effect of Shot-Peening and of Grinding on the Fatigue Strength of Chromium Plated High Strength Steel," by C. Williams and R. A. F. Hammond, 46th Annual Technical Proceedings, American Electroplaters' Society, 1959, pp. 195–204.

19 "Effect of Grinding Direction and of Abrasive Tumbling on the Fatigue Limit of Hardened Steels," by L. P. Tarasov, W. S. Hyler, and H. R. Letner, *Proceedings, ASTM*, vol. 58, pp. 538–539.

20 "Diamond Dressing Tools," American Standards Association, Am. Standard B67.1-1958, 7 pp., published by American Society of Tool Engineers.

21 "Markings for Identifying Grinding Wheels and Other Bonded Abrasives," American Standards Association, Am. Standard B5.17-1958, 7 pp.

Abstracts and Comments Based on Current Periodicals and Events

D. FREIDAY
Associate Editor

BRIEFING THE RECORD

Light of Nearly a Single Frequency

An "optical maser" which can produce intense light of almost a single frequency has been developed in the Hughes Aircraft Company's research laboratories in southern California. On the electromagnetic spectrum, radio waves of nearly a single frequency have been in use for many years, and extension of "coherence" to the infrared and optical spectral regions has long been desired. (The smaller the frequency band in which radiation is generated, the more "coherent" the source is said to be.)

The laser, as Hughes calls its device—still very much in the laboratory stage—represents the result of a research program in the optical spectral region. Instead of jumping a gap in the spectrum by a factor of five as has been done in the past 15 years, the laser represents a jump by a factor of 10,000 from previously attainable coherent sources. (See also the cover of this issue of Mechanical Engineering.)

In brief, the operation of the laser was described as:

1 A light source, in the form of a powerful flash tube lamp, irradiates a synthetic ruby crystal which absorbs energy over a broad band of frequencies.

2 This optical energy excites the atoms to a higher energy state from which the energy is reradiated in a very narrow band of frequencies.

3 The excited atoms are coupled to an optical resonator and stimulated to emit the radiation together; hence the acronym laser (Light Amplification by Stimulated Emission of Radiation). This is in contrast to ordinary light sources where the atoms radiate individually at random and the randomness is responsible for the incoherence of these latter sources.

To generate a monochromatic signal as bright as the laser's, an ordinary light source would have to have a temperature of several billion degrees—sufficient to disintegrate ordinary lamp materials. The laser is not hot but is a "cool" source in the ordinary sense of the word and therefore does not burn up.

Another important property of a laser, indirectly a consequence of its coherent, is that it radiates an almost perfectly parallel beam. It could, in principle, generate a beam less than 0.01 deg of arc wide which when reaching the moon, for example, nearly a quarter million miles away would illuminate a lunar area less than 10 miles wide. By contrast, if an ordinary searchlight could reach the moon, its beam would spread over 25,000 miles and its brightness would of course be correspondingly reduced. This follows from the fact that the searchlight is a finite-sized incoherent source. As another example, the laser beam if sent from Los Angeles to San Francisco would only spread 100 ft, while the searchlight beam would spread 50 miles.

A cube of synthetic-ruby crystal absorbs energy over a broad band of frequencies when it is irradiated by the light from a powerful flash tube. This optical energy excites the atoms to a higher energy state from which the energy is reradiated in a very narrow band of frequencies. This "coherent" light can be used for communication or for generating intense local heat.

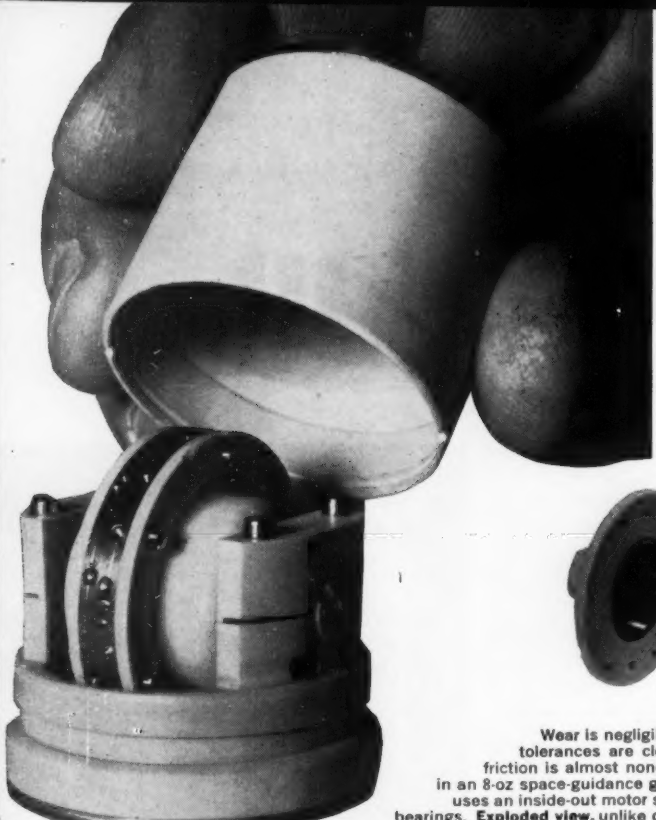
The laser's use in radar and communications for space work is obvious, since there is no atmosphere in space to absorb or scatter the beams. It could be used in effect as a light radar. The small beam spreading would give rise to extremely high resolution. A beam directed at the earth from a satellite 1000 miles up would be concentrated into an area about 200 ft wide.

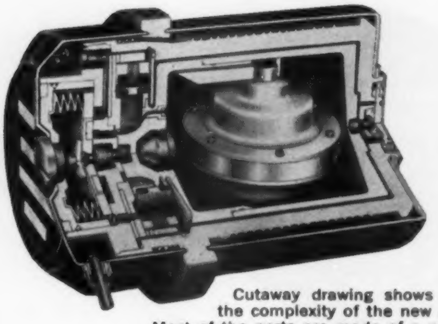
The minimum spot size that a coherent-energy beam can be focused into is approximately equal to the wave length of the radiant energy—in the laser range that would be between 15 and 30 millionths of an inch.

Therefore laser beams, in principle, could be concentrated to pinpoint size—a few ten millionths in. diam.

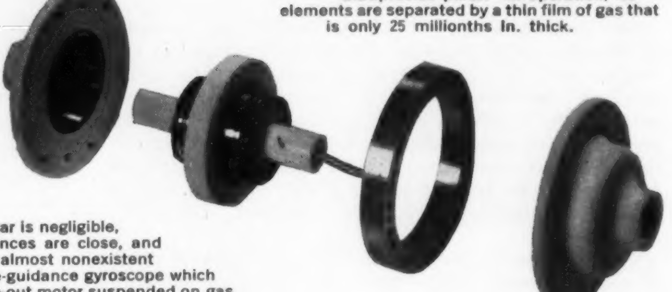
When energy is concentrated in such small areas, its intensity is very great and it therefore could generate intense local heat. It could probably be used industrially to modify surface areas or to induce chemical or metallurgical changes.

The Hughes research, conducted entirely at company expense, was under the direction of Theodore H. Maiman. Dr. Maiman was also responsible for developing the Hughes "ruby maser" amplifier, a 25-lb superdetector "electronic ear," for the U. S. Army Signal Corps' research and development laboratories.





Cutaway drawing shows the complexity of the new gyro. Most of the parts are made of a new ceramic material, as hard as sapphire, that is diamond-honed into tiny ultraprecise parts. In operation, its elements are separated by a thin film of gas that is only 25 millionths in. thick.



Wear is negligible, tolerances are close, and friction is almost nonexistent in an 8-oz space-guidance gyroscope which uses an inside-out motor suspended on gas bearings. **Exploded view,** unlike conventional motors, the outside parts—two end bells and balance ring—rotate. The shaft of the inside stator is clamped.

Ceramic Gas-Bearing Gyro

A CERAMIC gas-bearing gyroscope, said to represent a 10-fold improvement in gyro accuracy, has been developed by the Aeronautical Division of Minneapolis-Honeywell Regulator Company.

Honeywell's new gyro is only 2.817 in. long and 2.0 in. in diam and weighs only $^1/_2$ lb. In tests its superhard ceramic bearings have undergone many thousands of starts and stops without indicating any detectable wear.

The gyro was made possible by two major achievements. One was Honeywell's development of a ceramic material as hard as sapphire that can be diamond-honed into the tiny and ultraprecise shapes of critical gyro parts. The other was the development of a miniature ceramic self-generating gas bearing.

Honeywell described the ceramic-gas-bearing unit as the next generation in a family of gyros that began with the miniature integrating gyroscope, MIG.

MIG represented a miniaturization required by the advent of the missile age, of the "floated" or hermetic integrating gyroscope which was developed in the late 1940's by a team under the direction of C. S. Draper, Fellow ASME.

Like the MIG, the gimbal of the new gyro is floated to reduce friction torque. Flotation of the gimbal weight to better than 99 per cent has reduced friction to the order of a million times less than ball bearings.

This torque level, Honeywell pointed out, is approximately equal to the radiation pressure developed by shining a flashlight on a playing card that is hinged on one edge.

In a floated integrating gyro the input turning rates are converted by the gyroscopic element into gimbal torques. These torques are time integrated through a viscous fluid into gimbal displacements which may be read off directly by a displacement-type pickoff.

A practical mechanization of the floated-gyro principle results in a gyroscopic element (spinmotor) sealed within a cylindrical gimbal supported by a viscous fluid to obtain near-friction-free support.

Two categories of unwanted torques confront the gyro designer. The first is a friction torque that tends to mask off some lower level gyroscopic torques to limit the angular-rate threshold capability of the gyro. Second is an unbalance torque that comes from other than gyroscopic action and is erroneously measured as an angular motion.

Present, production, floated gyros with gimbal-flotation suspension reduce greatly the first category—friction torque. At the present time, advanced developments in externally pressurized air suspension are within reach to improve this area several orders of magnitude further.

It is the second category of unbalance torques that the ceramic gas-bearing spin motor significantly improves.

One of the most significant measurements of performance for a gyro is its drift uncertainty. Because the turning rate inputs to the gyro element are converted to gimbal torque, any unwanted, uncontrolled, torques applied to the gimbal cause errors to be introduced in the output response.

Unwanted torques may come from gimbal unbalance, electromagnetic reactions of pickoffs and torque generators, elastic restraint of the flex leads supplying power for the spin motor, or from the complex responses of the gyro under vibration inputs.

There is usually a fixed amount of unwanted torque in any one gyro that is consistent and repeatable and this

error can be balanced out by trim adjustment with little difficulty. Magnetic restraint and flex-lead elastic restraint are typical types of this fixed torque.

However, the gyro designer is still left with some unwanted torques that cannot be compensated because they are inconsistent. It is the latter torques that establish the true uncertainty level of the gyro and set performance limits for gyro drift.

Control of these inconsistent torques is where the ceramic-gas-bearing gyro has shown significant results. It has proved to be the solution to torques resulting from movement of the ball retainers and shifts of the balls in the race way, mechanical-hysteresis effects due to material damping and ball slippage, and stress and strain of the balls under angular motions of the gyro which cause deformations that change the balance of the gyro, and mechanical rectification of the vibrations set up by the ball bearings of the spin motor.

In the ceramic gas-bearing gyro the troublesome balls and retainers are eliminated, viscous damping is substituted for hysteresis damping, and deformations due to thermal expansion disappear. Vibration or bearing noise is decreased by a ratio of 30 to 1.

Gas such as air or helium has been found to be an effective bearing lubricant so long as the bearing geometry is proper. While the gas-lubricated bearing is in operation its elements are separated by a thin film of gas only 25 millionths of an inch thick. Since the film of gas is virtually friction free, wear is negligible.

The high modulus of elasticity, good thermal stability, and low long-term creep of ceramics are very desirable for the gas bearing where dimensional control and stability are prime factors.

They are even superior to beryllium for use in other parts of the gyro such as the gimbal, coil cup, and encapsulation of the spin-motor stator.

Contamination has always been critical in the manufacture of floated gyros. With extremely small clearances in the gas-bearing spin motor 1-micron dust particles (39.37 millionths) cannot be tolerated. The ceramic material is so rugged that it can be cleaned with hydrochloric acid which dissolves everything but the ceramic.

Ceramic gyro parts are rough cast in powdered form. The material can be worked easily in the half-fired "green" state. After final firing at 3200 F the material becomes as hard as sapphire.

It is finish-ground with diamond compounds to extreme accuracy and excellent surface finish. Tolerances on some parts of the new gyro are being held to less than three millionths of an inch.

Minneapolis-Honeywell has been conducting research in the field of close-tolerance ceramics for several years and recently began full-scale commercial production of precision ceramic components for military and industrial applications.

Since the initial development of the floated integrating gyro, Honeywell has produced over 30,000 floated gyros, more than any other gyro manufacturer.

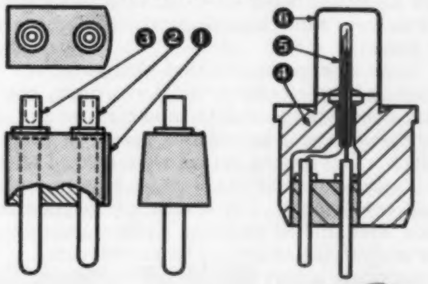
Expendable Immersion Thermocouple

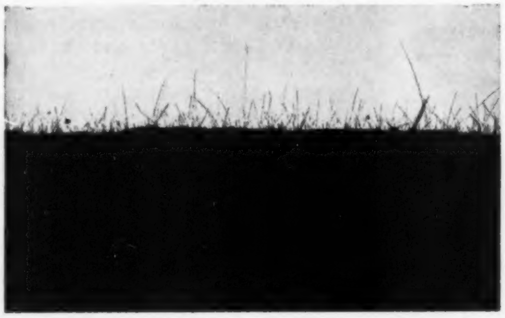
An expendable immersion thermocouple for rapid and reliable temperature measurement of molten steel is demonstrating unique and important advantages in bath pyrometry. Immersed into the body of molten metal, it reaches the metal temperature within seconds, the output signal being recorded to give a continuous temperature record. After immersion, the thermocouple unit is easily removed from its socket in the portable iron pipe in which it is used, to be replaced with a new one for the next reading.

At present it is designed for use at temperatures up to 3000 F.

Obviously, the use of a new thermocouple for each bath temperature measurement promises full assurance of positive performance as well as accuracy in individual readings. Equally important, however, the expendable immersion thermocouple offers advantages in speed, economy, convenience, and safety: (*a*) No rotational orientation is required when the thermocouple is assembled; (*b*) more rapid temperature response; (*c*) high accuracy of readings because the contact pins are insulated from temperature change—each thermocouple is annealed and factory checked for functional dependability; (*d*) molten metal cannot penetrate the assembly to damage the plug receptacle; (*e*) a minimum investment, since, in addition to the thermocouple unit itself, only an expendable cardboard protective sleeve, an iron pipe containing the thermocouple lead wires, and the receptacle assembly are required.

The design of the new Engelhard thermocouple is as simple as it is efficient. It consists of a ceramic base 1 to which are anchored two pins, one of copper 2 and the other of Number 11 alloy 3. The thermocouple wires (platinum-platinum 10 per cent rhodium or platinum-platinum 13 per cent rhodium) are crimped to these pins. This base assembly is taper-locked into a ceramic-plug body 4. A transparent fused-silica tube 5 protects the thermocouple wires and is firmly cemented into the body. To protect the silica tube from slag and floating solids upon immersion, a special metal cap 6 is provided which later melts away.





The effect of water vapor upon the rusting of iron is clear in these two electron-microscope photographs, taken at identical magnification. In a dry oxygen atmosphere, **left**, the iron forms a protective oxide coating thickly populated with tiny whiskers about 30 millionths in. high. In an atmosphere of pure water vapor, **right**, the surface erupts into thin blade-shaped oxide crystals which reach a density of nearly 1 billion per sq in.

New Theory for Rusting of Iron

Westinghouse Research Laboratories have advanced a new basic explanation for the corrosion of iron—estimated to waste some $6 billion to $7 billion per yr in the United States alone. Westinghouse researchers Earl A. Gulbransen and T. P. Copan suggest for the first time that the true culprits are hydrogen ions or protons.

The hydrogen ions come from water vapor, which must be present if iron is to rust to any great extent at room temperature. Their theory suggests that the tiny hydrogen particles penetrate the iron and enlarge the sites at which oxygen normally combines with the metal. This spreads the reaction throughout the surface of the iron, causing it to rust destructively.

Until now, a "standard" explanation for iron corrosion is that it is an electrochemical reaction, somewhat similar to that which occurs in an ordinary battery. Tiny local areas on the surface of the metal are assumed to act as plus and minus electrical terminals under the influence of an invisible liquid film of water, generating minute electric currents that corrode the iron. The new theory suggests that something more fundamental takes place in the iron, even though an electrochemical reaction may also be present.

In a series of experiments that eliminated the conditions required for electrochemical reactions, the Westinghouse scientists reduced the complex rusting of iron to its simplest atomic processes. Pure iron wires about as thick as a fine sewing thread were reacted with oxygen and water vapor at 835 F under closely controlled, idealized conditions. The results of the minute-scale corrosion were studied under an electron microscope capable of magnifying objects up to 300,000 times.

The scientists report that with dry oxygen the iron forms a protective oxide coating from which grow billions of tiny round oxide whiskers less than 1 millionth in. in diam and 30 millionths in. high. Each whisker grows from a single, specific growth site on the wire's surface, much as individual seeds sprout from the ground into separate plant stems. Then the wires were reacted under identical conditions except that water vapor was substituted for the dry-oxygen atmosphere.

The moisture produces a startling change in the oxide surface. From the growth sites erupt thin, pointed, blade-shaped platelets of iron oxide that spread across the metal surface. Shaped somewhat like blades of grass, they are about 1 millionth in. thick, 30 millionths in. wide, and 300 millionths in. high. As they grow in size, they spread more than 50 times in area over the sites observed for dry oxygen alone, reaching a density of nearly 1 billion per sq in. of surface area. The amount of iron rust they represent is 250 times that which forms when the water vapor, and the hydrogen ions it releases, are absent from the reaction.

The experiments by the Westinghouse scientists show that less than one part of water vapor in 200 parts of the dry-oxygen atmosphere will cause the blade-shaped crystals to form. At room temperature this would correspond to a relative humidity of about 3 per cent.

"We conclude that the hydrogen ions in the water vapor enlarge the areas of chemical reaction between the oxygen and iron and bring about the metal's greatly increased corrosion," Dr. Gulbransen declared. "At the lower temperatures at which iron usually rusts, this basic reaction is masked. Complex corrosion products are formed and are not stable, and the corroding metal is often removed from the reaction site. Once such basic understanding is at hand, we should be able to do a much better job of controlling corrosion. Already we can identify two control measures which must be considered in addition to any electrochemical effects that are involved in iron rusting: Hydrogen must be prevented from entering the metal, and the growth of the localized reaction sites must be inhibited by the addition of suitable alloying elements to the iron."

"Unthawing" Oil Reserves

Raytheon Company, Norwood, Mass., revealed today that it has under development an electronic oil-well heater, utilizing deep-penetration radar beams, which may aid in the recovery of some of the vast unworkable oil reserves. These are estimated at seven times those economically recoverable by present methods or about 182 billion bbl in the U. S. alone. An agreement with Petro-Electronics Corporation of Denver, Colo., provides for the contribution of geological and oil-production experience.

If the temperature of oil-bearing rock thousands of feet underground can be raised 20 deg in a 2-ft area around the well bore, petroleum engineers feel the yield of many wells can be increased. Special electronic gen-

erators of very high frequencies, in the microwave band, would be used to provide quick-acting, penetrating heat.

A 6-in-diam capsule containing 5000 to 10,000 watts of power will be lowered into a low-producing 3500-ft-deep well in northwestern Montana for the first field tests. Other depths and formation types will be tested later.

Direct Converter Uses Ordinary Fuel

A THERMIONIC ENERGY CONVERTER, which employs readily available materials and a noncritical design, has been developed at RCA Laboratories, Princeton, N. J., as part of a research program under a contract from the Air Force Cambridge (Mass.) Research Center.

It has been operated in tests from heat sources of 2012 F—equivalent to the temperatures produced by burning standard fuels such as gasoline and natural gas—and has converted up to 14 per cent of the heat energy directly to electrical energy.

Capable of generating either direct or alternating current at frequencies up to about 1 million cps, its power output could be suited to driving virtually all types of electrical equipment.

Previously, tubes of this type have been operated with acceptable efficiency only from special heat sources producing temperatures well over 3632 F. Other thermionic devices capable of operating from lower temperature sources have had the disadvantage of extremely critical construction, raising serious problems from the standpoint of economical mass production.

Accelerated Fatigue Testing

"RESONANCE-BENDING" techniques are reducing to minutes the time required to determine the probable years of service in the life of metal pipe. Tube Turns Division of Chemetron Corporation, Louisville, Ky., sets lengths of pipe to vibrating in their natural-resonance frequency, literally shaking themselves until they crack at the point of fatigue failure.

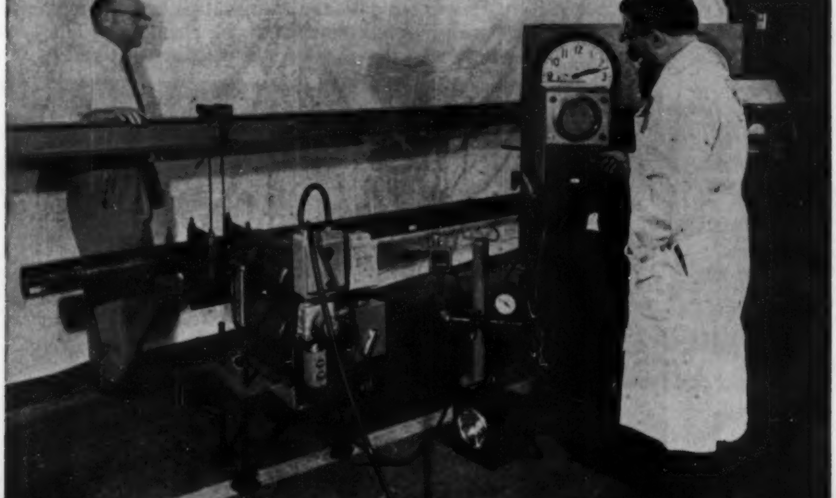
According to J. D. Mattimore, Mem. ASME, vice-president for product engineering and research, forced vibrations emanating from eccentric weights spun by an electric motor induce a sympathetic vibration in test lengths of pipe at their natural-resonance frequencies. Cycles of several thousand per minute are readily achieved. Carbon-steel pipe or fittings with $^1/_2$-in. wall thickness can be vibrated to fatigue failure in less than half an hour, closely simulating the stresses and strains to be encountered in years of service in industrial plants and cross-country pipelines. At 400 cpm, for example, and at a measured amplitude of vibration, a million known operating cycles in an industrial piping system can be duplicated by resonance bending in just 4 hr and 10 min.

Mattimore stated that a future application for resonance bending may be the rapid determination of the fatigue life of new metals and alloys as they are developed for nuclear and space-travel piping requirements. The new method is said to be five to six times as fast as present methods for cyclic bending of steel pipe by mechanical means or the much slower pulsating application of water pressure, and is substantially more economical from a standpoint of power requirements, manpower, equipment investment, and maintenance.

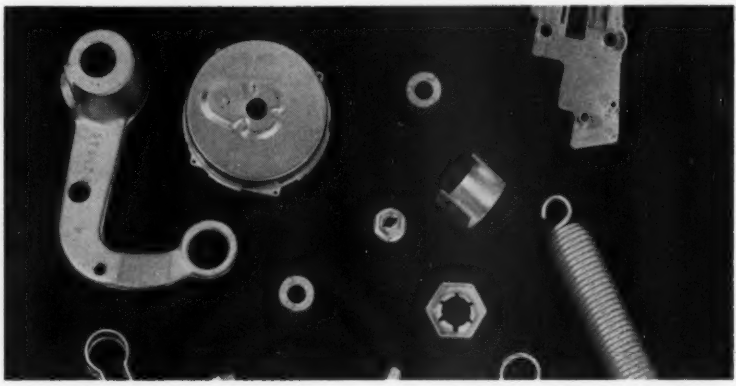
Set up for testing at Tube Turns Product Engineering & Research Laboratories, steel pipe cut to calculated lengths of about 10 ft is suspended freely from an overhanging steel beam. Points of suspension match the natural node points which, together with the pipe's natural-resonance frequency, are calculated as a function of the composition of the metal, length, wall thickness, and other factors. Under one of the points of suspension, unbalanced weights, geared to an electric motor, are spun at a calculated number of rpm to set up forced vibrations that induce a sympathetic vibration or "resonance" in the test piece of pipe. The system is based on a method first used in England to determine fatigue characteristics.

Once the test piece of steel pipe is "locked in" on its natural-harmonic frequency and vibrating freely, the amplitude of vibration can be increased by stepping up the output of the motor. Amplitude can be observed on a sine curve reproduced on an oscilloscope using strain gages attached at the point of maximum stress, midway between the node points along the test specimen, or on visual deflection cards mounted on the pipe. The visual cards can be "stopped" by the action of a stroboscopic light, enabling determination of the rate of vibration.

Ends of the pipe are sealed and the pipe is put under 10-psi air pressure during testing. Development of a fatigue crack through the pipe wall permits air leakage; a drop of 1 psi controls an automatic switch that cuts off the drive motor, stopping the forced vibration and a timing device, permitting accurate measurement of the number of cycles to failure. Without it, the pipe could continue to vibrate freely in its locked-in frequency until the fatigue crack became extensive enough to cause a change in the natural-resonance frequency of the test specimen, which would then be reduced to harmless nonsynchronous shaking in place of its self-destructive natural-hormonic vibration.



Years of fatigue are compressed into minutes by resonance-bending tests of metal pipe and fittings. Research engineers Everett C. Rodabaugh, Assoc. Mem. ASME, **left**, and Edward E. Tassi induce vibration in this 4-in. carbon-steel pipe at approximately 4300 cpm.



Metal parts are mechanically plated for corrosion protection in an operation carried out in a standard rubber-lined tumbling barrel. Only water needs to be added to the plating metal, which is in powder form, and the impact media.

Mechanical Plating System

A METHOD of plating metal parts for corrosion protection, announced by Minnesota Mining and Manufacturing Company, St. Paul, Minn., eliminates hydrogen embrittlement as a problem in plating high-strength steel. Capital investment and operating costs are lower than for other plating methods.

Called the Mechanical Plating System, it is primarily designed for applying protective metal coatings, and has been licensed to a limited number of selected plants in the fastener, spring, and powder-metallurgy industries in the north-central and eastern states. The 3M company has adopted the tradename Dyko. Development work toward broader applications is under way.

The operation is carried out in a standard, rubber-lined tumbling barrel.

Parts to be plated are cleaned, the specially prepared plating metal in powder form is weighed out, 3M Promoter Chemical and 3M Impact Media are added, and the charge is covered with water. Then the barrel is rotated for about 45 min.

When the cycle is completed, plated parts are separated from the impact media, which are washed for reuse. Water and spent chemicals are drained directly into the sewer without need of treatment—there is no disposal problem.

Thickness of plate is controlled by the quantity of metal powder added to the tumbling barrel, and thicker-than-normal coatings can be obtained with the same equipment and in approximately the same time by merely adding more plating metal. Present commercial installations are for applying zinc coatings, and the method is under test for extension to cadmium and other metals.

Alloy coatings are applied as simply as pure metals. Small metal parts and assemblies, some of which could not be successfully plated by other methods because of design factors, can be mass plated. Hydrogen embrittlement, a serious problem, has been eliminated. It is not necessary to bake parts after plating.

The plating process is controlled by the 3M Promoter Chemical. The 3M Impact Media, composed of special glass particles, consolidate and cold weld the metal particles into a dense, continuous, and adherent coating.

Air-Luggage Handling Improved

LUGGAGE is waiting for the passengers by the time they reach the lobby at the new United Air Lines terminal at New York's Idlewild International Airport.

The use of 11 fiberglass preload containers, shaped to fit compartments in the underside of DC-8 fuselages, which are lowered by electric hoists, makes this possible.

The containers are then moved swiftly to a concourse baggage room, where individual bags are placed on a conveyer system which speeds them toward the lobby claiming area.

A constant speed is maintained in the system by 12 power-operated curved belts winding through the terminal basement. Goodyear Tire and Rubber Company engineers developed special belting to travel around curves of varying radiuses at speeds up to 300 fpm.

As the baggage enters the claiming section, a moving diverter takes over and gently distributes suitcases at 2-ft intervals along a tilted stainless-steel rack.

The passenger merely steps up to the rack, picks up his bag, and hands the claim check to an attendant. Supermarket-type carts for transporting luggage to the terminal entranceway are available at no cost to the passenger.

Three thousand feet of Goodyear conveyer belts are used in the system engineered and manufactured by Mathews Conveyer Company of Ellwood City, Pa. These carry baggage the entire length of the incoming and outgoing systems. Other links in the over-all system speed luggage from a limousine-unloading station and from express check-in counters to the concourse baggage area, where it is transferred to outgoing planes.

Luggage is ready for air travelers by the time they reach the lobby with a new handling system used at Idlewild. Over 3000 ft of conveyer belting, traveling at speeds up to 300 fpm wind through the terminal basement

Two stainless-steel subway-elevated cars a day will be turned out on two 1/4-mile-long assembly lines. The cars will provide faster and more economical service on Philadelphia's Market-Frankford line.

Stainless-Steel Subway Cars

THE City of Philadelphia has ordered 270 stainless-steel subway-elevated cars from the Budd Company of Philadelphia to replace completely the present equipment on the Market-Frankford line, most of which is over 50 years old. The $25-million order is the first to specify stainless steel for a fleet of rapid-transit cars.

A transverse seating arrangement with up to 56 seats per car provides the greatest number of seats for the size of the unit. Automatic pressure ventilation, wide tinted-glass windows, fluorescent lighting, all-plastic interior, fast acceleration, and a smooth-riding, air-spring suspension system are other features.

The lighter weight of stainless steel makes possible cars with an average weight of only 51,000 lb—the lightest of their size—and will result in proportionately lower electric power costs for propulsion. The corrosion-resistant finish of stainless steel provides a virtually maintenance-free exterior. The combination of these savings in operation and maintenance is calculated at approximately $6.5 million during the 35-yr depreciated life span of the fleet of new cars.

The 270-car order includes three related types of cars: 46 are Single Units with a motorman's cab at each end and a complete set of propulsion and braking equipment. The remainder are 112 semipermanently coupled pairs of one A Unit and one B Unit, each having only one control cab and operable only when joined together. All cars are 55 ft 4 in. long.

Each car is powered by four, 100-hp traction motors geared for an acceleration rate of 2.75 mph per sec—almost three times as fast as the cars they replace. It will make possible a 6-min reduction in running time over the 12.8-mile, 28-station line.

Every new feature of the cars has been thoroughly tested. The basic stainless-steel structure of the car was compression tested at a static load of over 200,000 lb without any permanent deformation, giving a margin of strength in excess of American Transit Association standards.

Precipitator Data

A MOBILE pilot electrostatic precipitator has been designed and built by the Metal Products Division of Koppers Company, Inc., Baltimore, Md., to provide engineering data on various power-station precipitator operations. It will permit more accurate evaluation of the effect of such precipitator operating conditions as gas velocity, rapping intensity, field length, and power requirements.

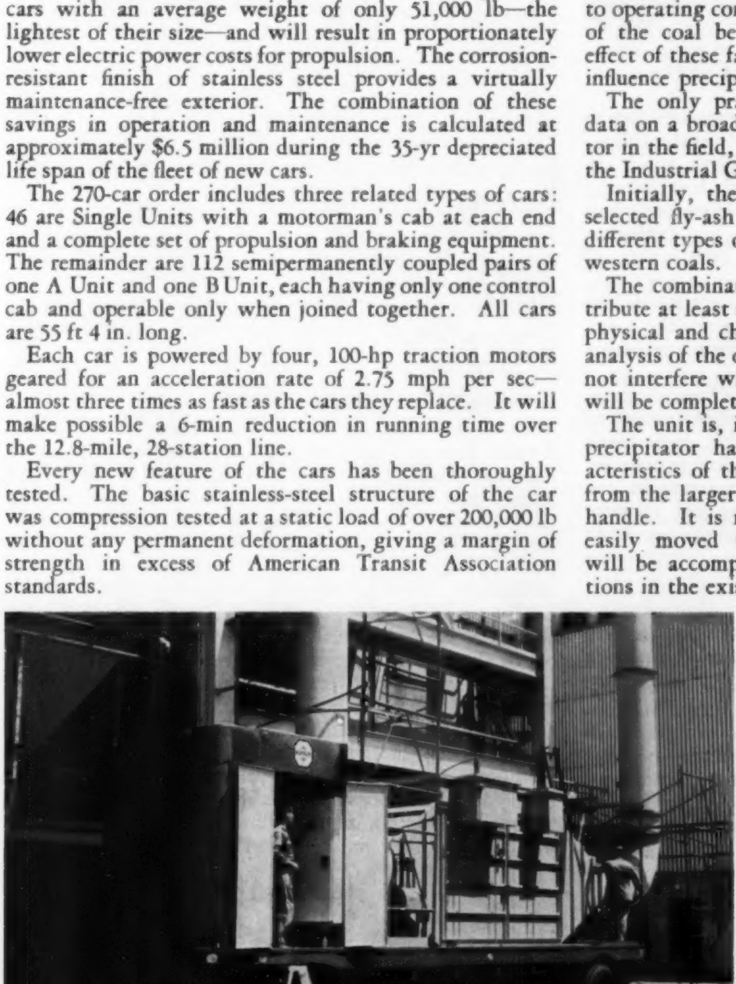
The company states that, since the trend in power-plant design is toward ever-increasing capacity, the data on which electrostatic-precipitator design is based may soon be inadequate. It will also be necessary to closely relate the physics and chemistry of the flue gas to operating conditions and to the physics and chemistry of the coal being fired. Better understanding of the effect of these factors and how their various interactions influence precipitator performance is needed.

The only practical way to obtain these functional data on a broad scale is to put a mobile pilot precipitator in the field, according to D. L. De Vries, manager of the Industrial Gas Cleaning Department of Koppers.

Initially, the unit will be operated at six carefully selected fly-ash installations which will include three different types of boilers burning both eastern and midwestern coals.

The combinations of coals and boiler types will contribute at least six flue gases having sufficiently different physical and chemical properties to permit a statistical analysis of the effect of variances. The mobile unit will not interfere with the station's operations, and testing will be completed in a few weeks at each location.

The unit is, in reality, a small full-scale electrostatic precipitator having all of the components and characteristics of the largest fly-ash precipitator. It differs from the larger units only by the volume of gas it will handle. It is mounted on a trailer truck and will be easily moved to the various locations. Installation will be accomplished in a short time through connections in the existing duct work.



A small mobile full-scale fly-ash unit will be used to evaluate the effects of various operating conditions on electrostatic-precipitator performance. A variety of coals will be tested in various types of boilers with various firing methods.

Gas Mixture for Explosive Forming

An experimental electrolytic gas cell generating an oxygen-hydrogen mixture is a promising fuel source for explosive metal-forming operations and high-temperature welding and cutting torches, according to Battelle Memorial Institute.

When exploded, the gas mixture creates pressure 10 times greater than the starting pressure, which is limited only by the strength of the container. For example, a 1500-psi mixture on a 2000-sq-in. working surface would produce a peak explosive force of 15,000 tons when ignited. Possible applications include forming large-sheet parts of the type used in the aircraft and missile industry.

The generator consists of a number of flat nickel-plated steel electrodes placed 0.060 in. apart in a plastic or insulated-metal container holding a weak caustic solution. Current is run into the two outside electrodes with the intermediate ones functioning as bipolar electrodes. Voltage between the electrodes averages two volts. Volume of gas generated can be increased by increasing the number of electrodes.

An oxygen-hydrogen mixture of approximately 8 to 1 by weight produces the highest flame temperature, fastest detonation, and greatest increase in pressure when ignited. Estimated cost of producing the gas is 10 to 30¢ per 100 cu ft, depending on electric-power costs.

Using gas for explosive-forming operations may provide some advantage over conventional methods. When solid or liquid explosives are used, pressures of millions of psi form the metal within a few microsec. Shock waves are reflected and reinforce the next wave, sometimes doubling the impact and causing the workpiece to crack.

In contrast, gas explosions produce pressures up to hundreds of thousands of psi lasting several millisec and have a different shock pattern. With solid explosives, the shock wave goes to a high level almost instantaneously, remains there for a few microsec, then drops abruptly. The shock wave of a gas explosion rises to a peak within several millisec, then tapers off gradually.

The device is safe since the autoignition temperature of the gas mixture is about 605 C. Also, since the gas is generated only as needed, shipping and storing problems are eliminated.

Used in welding and cutting torches, the burning gases can produce temperatures above 2000 C—hot enough to cut and weld steels, aluminum, and nickel; melt platinum; and fuse alumina. Flame temperature can be controlled by varying the amount of moisture in the gases. Trace amounts of caustic in the gas mixture create a yellow flame, making it visible and thus easier to control.

200,000-Kw Combined-Cycle Plant

The Oklahoma Gas and Electric Company will add 200,000 kw of combined-cycle steam, gas-turbine electric-power generation to the Horseshoe Lake Station, 20 miles east of Oklahoma City. When completed in 1963, the new combined-cycle plant is expected to be at least 4 per cent more efficient than a comparable conventional power plant of similar capacity. The General Electric Company is prime contractor and Sargent and Lundy will design the plant.

Nuclear Briefs

▶ Nuclear-Powered Remote Telemetry

An automatic electronic telemetry station powered by nuclear energy and capable of recording data and transmitting it from a remote ground location for at least two years without refueling or servicing is being developed by the Martin Company under a contract from the U. S. Atomic Energy Commission.

To demonstrate its capabilities, the device will be linked with weather instruments to measure temperature, wind speed, wind direction, and barometric pressure; but it could be modified easily to detect seismic disturbances or to record continuously any other type of information in a hard-to-reach spot.

Energy will be supplied by a 5-watt strontium-90 thermoelectric generator similar in principle to the SNAP 1-A and SNAP-3 units built by Martin for the AEC. (SNAP stands for "Systems for Nuclear Auxiliary Power.") The output of the generator will be stored in conventional nickel-cadmium batteries. Besides translating the measurements into electronic code form, the station will use a sudden burst of power every three hours to broadcast the data.

▶ Boron Stainless Composites for Reactor Control

Bo-Stan, a new, high-temperature, flux attenuator for reactor control is strong, easily fabricated, resistant to corrosion and high temperatures, and of particular interest for pressurized-water reactors. A carefully balanced, uniform dispersion of boron in stainless steel, it is prepared by the Sinterwrought process, an advanced powder-metallurgy technique developed by the Sintercast Division of Chromalloy Corporation, Yonkers, N. Y.

Being produced by a solid-state process, the resulting material is readily predictable, reproducible, and homogeneous. After sintering and hot-working, the composite is as fully dense, ductile, and strong as a cast alloy of equivalent composition.

It greatly reduces the tendency of boron literally to ooze out of alloys of boron and stainless steel, especially during hot-working, which drastically alters their neutron-capturing ability.

Moreover, special blending techniques employed by Sintercast have all but eliminated the tendency of boron to segregate.

▶ Largest Reactor Vessel Yet for EGCR

The subcontract for the reactor pressure vessel for the Atomic Energy Commission's Experimental Gas-Cooled Reactor, EGCR, the largest ever fabricated in the United States, has been awarded to Baldwin-Lima-Hamilton Corporation by the H. K. Ferguson Company, prime contractor. The 22,000-net-ekw EGCR under construction at Oak Ridge, Tenn., is estimated to cost $30 million.

The pressure vessel will contain the graphite-core structure, fuel assemblies, and control rods. Cylindrical in shape with hemispherical top and bottom heads, the vessel will have 20 ft ID and an inside height of about 46 ft. A 1-in. stainless-steel liner, attached to the interior of the vessel, will serve as the temperature barrier. The thickness of the outer carbon-steel shell will vary from $2^3/_4$ to 4 in. The vessel will be penetrated by nearly 100 holes, principally in the top and bottom heads, for nozzles for coolant-gas flow, control rods, experimental loops, fuel changing, and instrumentation. When

installed, the vessel with the attached nozzles will be more than 75 ft high.

The 350-ton vessel will be fabricated and tested in Baldwin-Lima-Hamilton Corporation's Philadelphia facilities and cut into two major pieces after testing for shipment by barge to Oak Ridge. The bottom section will be installed within a year. After the reactor graphite and instrumentation have been installed, the top section will be welded into place and the nozzle extensions completed.

Completion of construction of the EGCR is scheduled for late 1962.

▶ U. K. Nuclear Power Program Slows Down

The latest White Paper on the U. K. Nuclear Power Program indicates a further slowing down of the ambitious scheme to provide 5000 to 6000 mw by 1966, according to the July, 1960, issue of the British *Nuclear Engineering*. The date for completion of the program is now 1968. Orders for nuclear stations will continue to be placed at the rate of one per year.

Five nuclear power stations are being built and two more have been approved. The earlier stations will come into operation in 1961 and all seven should be in operation by 1966, with a total output capacity of approximately 3000 mw. To reach a total capacity of 5000 to 6000 mw by the end of 1966 it would be necessary for the Electricity Authorities to place exceptionally large orders for nuclear capacity during the next two years for commissioning in 1965 and 1966.

Since 1957, coal has become plentiful and oil-supply prospects have improved, reducing the immediate need for additional nuclear capacity. The reduction in capital cost through the development of large generating sets, increased efficiency through the use of higher steam temperatures and pressures, and location near low-cost-coal sources have all improved the competitive position of fossil-fuel power generation.

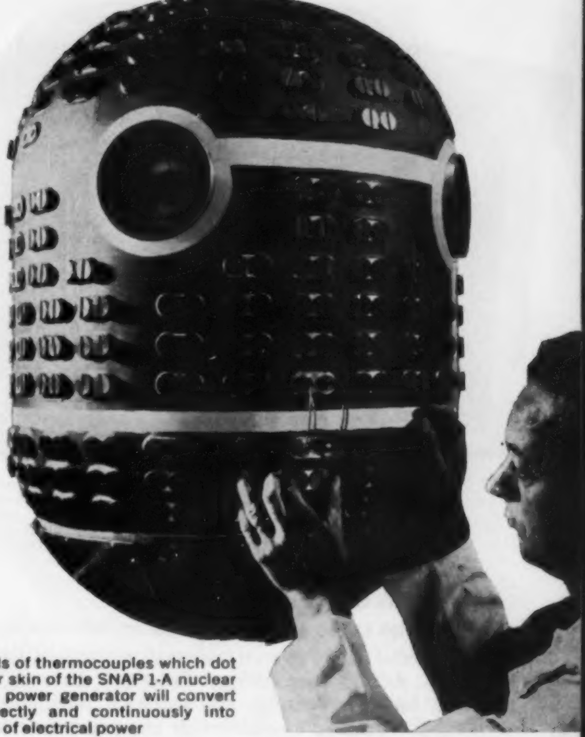
By 1970, base-load generation by nuclear means will be cheaper than conventional generation provided the technological progress that is expected is achieved. The Government is advised that in the long run the U. K. will best be served by nuclear power. The one-a-year rate of nuclear-station construction is regarded as sufficient to maintain the rate of development of nuclear technology. It should also sustain a nuclear-plant industry capable of competing for overseas business and of expanding to meet the higher level of future needs.

▶ Nuclear Altimeter Uses Beta Back Scatter

A contract to continue research on a nuclear altimeter has been awarded Tracerlab, Waltham, Mass., by Picatinny Arsenal, Dover, N. J. The nuclear altimeter will differ from a conventional altimeter in that it will utilize ultrasensitive nuclear "beta back-scatter" techniques developed by Tracerlab, for altitude sensing. These techniques are already being applied for material-thickness measurement and process control.

In this new airborne role, beta back-scatter will be used to sense atmospheric density at varying heights above the earth's surface. Because atmospheric density is related to height, the instrument will be able to give direct accurate indications of altitude.

The work will be done in co-operation with the scientific staff at Picatinny Arsenal and the Aeronautical Engineering Laboratories at M.I.T.



Hundreds of thermocouples which dot the outer skin of the SNAP 1-A nuclear auxiliary power generator will convert heat directly and continuously into 125 watts of electrical power

▶ SNAP 1-A Will Have 125-Watt Output

SNAP 1-A, another System for Nuclear Auxiliary Power, has the highest output of any of this family of generators. It produces 125 watts of electricity without moving parts.

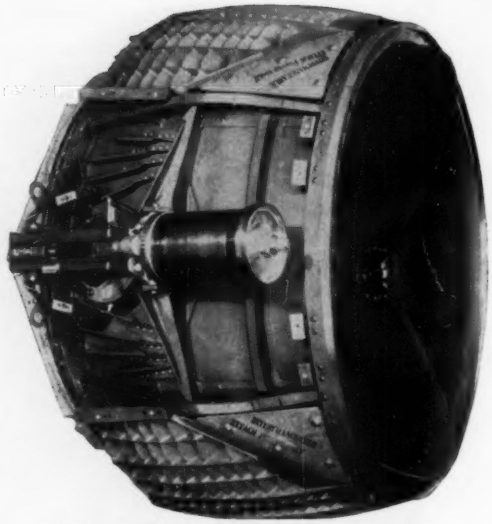
Roughly egg-shaped, 34 in. long, and 24 in. in diam, the device now undergoing tests by The Martin Company, Baltimore, Md., has most of its dull metal surface dotted with screw-headed caps marking the location of 277 thermocouples. The complete generator weighs 175 lb.

The fuel capsule containing tightly sealed pellets of Cerium-144, a nuclear-fission by-product, will be located at the very center of the generator, supported by light metal tubing.

The difference in temperature between the inner and outer ends as the inner ends of the thermoelectric elements are heated produces a small electric current in each pair. These thermocouples are connected in series to add up to 125 watts at 28 volts.

As the radioisotope decays, the amount of heat it produces will gradually decrease. For this reason, SNAP 1-A has been built with a temperature-sensitive shutter which will let some of the heat leak out at the beginning of operation but will gradually clamp shut. Thus the electrical output will remain constant at 125 watts for a full year and then will taper off.

During ground-handling operations before launch, the hollow interior of SNAP 1-A can be filled with liquid mercury, which acts as a shield for its radiation. This could be drained, moments before lift-off, to reduce the weight of the payload.



Bearing assemblies for the clamshell mechanism of Boeing's thrust reverser are made of Lesco BG 41 Vac Arc, a special grade of stainless steel

Materials Briefs

▶ Lesco BG 41 Vac Arc Bearing Steel

A special grade of stainless steel, designated Lesco BG 41 Vac Arc by Latrobe Steel Company, Latrobe, Pa., is being used for bearings and races for Boeing jetliners. Used for bearing assemblies in the pneumatically controlled mechanism which reverses the forward thrust of the aircraft engines, it is subjected to a maximum compressive stress of more than 600,000 psi and temperatures in excess of 800 F as the giant airliners are brought to a stop following their high-speed touchdowns on airport runways.

Produced by the vacuum consumable-electrode process, its chemical composition is 1.10 C, 0.30 Mn, 0.30 Si, 14.50 Cr, and 4.00 Mo—a modified form of AISI Type 440-C stainless. Increasing the molybdenum content from about 0.005 to 4.00, the company says, provides the necessary "hot hardness." At elevated temperatures this is 3 to 5 points Rockwell C above that for 440-C stainless. When exposed for 400 hr at 900 F the BG 41 shows a drop of only 8 per cent in hardness, compared to an 18 per cent drop-off with 440 C.

▶ Cladding Ceramic Fuels With Corrosion-Resistant Materials

Materials for ceramic-fuel-element cladding applications, fabrication techniques for required fuel-element configurations, and evaluation of the procedures that are developed will be performed in a new facility at Allis-Chalmers, Greendale, Wis., Laboratories. Various methods of bonding the cladding material to ceramic fuel have also been developed. New developments will be incorporated into the Pathfinder Atomic Power Plant being constructed by Allis-Chalmers for Northern States Power Company.

To measure characteristics of ceramic-fuel materials, the staff utilized hydraulic die press and sintering equipment, a ball mill, feed-blending apparatus, and sieve or subsieve analysis. The development of fabrication techniques will be aided by a mass-spectrometer leak detector, swaging machine, and a recently installed hydraulic draw bench with 20,000-lb pull.

▶ Aluminum Power-Transmission-Line Towers

Commonwealth Edison Company has placed in service 44 aluminum towers on a six-mile run in suburban Chicago, from Tiedtville to Hodgkins, Ill. The towers are part of a 50-mile, 138-kv link between Edison's new Dresden Nuclear Power Station and its McCook substation.

Installation of the aluminum structures, designed and fabricated by Aluminum Company of America, followed full-scale tower tests for the line.

The line was built to provide a comparison of the relative costs of erecting and maintaining aluminum towers, in contrast to conventional steel towers.

▶ Simplified Steel Power-Transmission Towers

Construction costs have been cut over 30 per cent for savings of $3.8 million on the 620-mile-long 380-kv Messaure-Hjalta and Kilforsen-Orebro transmission lines under construction by the Swedish State Power Board.

Two widespreading legs instead of four are used, and these are of uniform thickness regardless of height. Stability is attained by the use of four truss wires running from the cross arm to the ground. Foundations are also relatively small, requiring only 1800 lb of steel. More data are given in the July, 1960, *Power Engineering*.

▶ "Blueprint" for Superweldable Steels

Several 1-ton pilot heats of Kromarc, a high-temperature, high-strength, highly ductile, and superweldable stainless steel, have been made by the Westinghouse material manufacturing department, Blairsville, Pa. Hot-cracking susceptibility of 1200 test samples of more than 100 different alloy compositions were made with a special accelerated cast-pin-tear test in developing the new weldable steel.

The basic composition chosen for study was an austenitic stainless containing 16 per cent chromium and 20 per cent nickel.

The effect on hot cracking of varying the concentration of these base elements and 16 additional alloying elements then was quantitatively determined.

It was found that manganese must be much higher than that normally employed in chromium-nickel steels, and silicon must be low. Higher strengths should be obtained by adding molybdenum or tungsten. If even higher strength is required, the preferred addition is tantalum, not titanium or columbium. The concentration of carbon should be low, although that of nitrogen can be relatively high.

▶ Epoxy Resin Potting and Dipping of Computer Components

Epoxy resin is being used in the potting and dipping of computer components for protection against humidity, contamination, shock, and vibration. The assemblies given this protective treatment by Librascope Division, General Precision, Inc., Glendale, Calif., are printed-circuit logic cards. Epoxy resin, which has extreme resistance to heat, cold, and abrasion, may be applied at room temperature and then set at temperatures low enough to prevent damage to the sensitive precision transistors, diodes, resistors, and capacitors which make up the logic-card circuits.

After leaving the coating section, the circuit boards are baked at a maximum temperature of 150 F to harden the thermosetting epoxy. The temperature control is critical, since it is vital that the heat be adequate to cure the plastic without damaging the performance of the delicate electronic components.

Masking tape, which is used to keep contacts and terminals free from the plastic coating, is removed after the boards leave the ovens.

Where two or more circuit boards are joined in parallel to form an open-sided boxlike construction with electronic components on both the inside and outside of the box, the parts on the inside are protected by filling the space with potting compound.

Epoxy is also used in the potting, with special fillers added to provide maximum heat dissipation. The boards are placed in jigs and the liquid plastic resin poured in. The assemblies are then oven cured in the same manner as the coated boards, and the jigs removed.

▶ Koroseal Vinyl Electrical Conduit

Rigid Koroseal vinyl electrical conduit, said to permit savings up to 60 per cent in installation costs, is recommended by B. F. Goodrich Industrial Products Company, Akron, Ohio, a division of the B. F. Goodrich Company, for all types of electrical conduit systems and telephone circuits wherever cinder fills, wet locations, or corrosive atmospheres cause metal conduit to corrode or rust out.

Because of its flexibility, Koroseal conduit fits the contours of installations, can be quickly snaked into place whether the runway routing is in earth, poured concrete, or hollow walls. Since Koroseal conduit weighs only one eighth to one quarter as much as metal conduit, shipping costs are reduced and lighter structural supports can be used. The material comes in 20-ft lengths, which require fewer joints than conventional conduits.

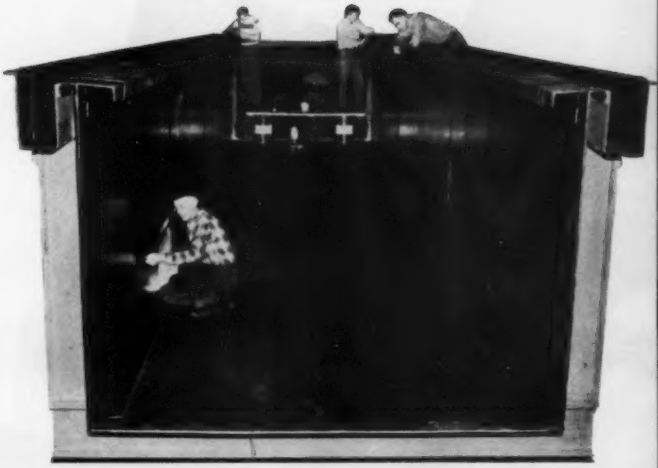
Fire-resistant and self-extinguishing, it will not support combustion. It is nonmagnetic and will not spark when struck. It can be cut with an ordinary handsaw, tubing cutter, hack saw, or power saw, and can be bent easily after heating. It can be threaded with the same tools used for metal or joined by solvent welding to provide a joint stronger than the conduit itself.

▶ Sprayable Plastic Coating in Water Suspension

Pfaudlon 301, a new sprayable coating of Penton in water suspension, has been introduced by the Pfaudler Company, a division of Pfaudler Permutit Inc., Rochester, N. Y.

Penton is a chlorinated polyether polymer developed by Hercules Powder Company. It has almost universal resistance to corrosion at temperatures up to 250 or 275 F, and resistance to abrasion and impact damage is excellent. Pfaudlon 301 is applied in approximately the same manner as are organic suspensions. The surface to be coated is first cleaned by sandblasting or other methods. A film of suspended resin is then applied with standard spray equipment. Water is driven off and the coating is fused to the metal at 400 to 500 F. Though this method is similar to that used with organic suspensions, Pfaudler believes that the water-spraying technique is superior because elaborate safety measures are not needed to guard against toxicity and flammability.

The plastic coating can be applied to desired thickness of 20 to 40 mils with as few as two applications, while four or more are commonly required when alternate methods are used. Parts do not require preheating as in existing dry-coating techniques, and complex shapes can be easily covered with the surfaces not requiring the coating easily excluded. A superior bond is obtained between the metal surface and the resin.



A three-ply course of acid-resistant Trioweld, a specially compounded rubber, is applied to a section of a 391-ft steel-pickling line. Each section is vulcanized in a giant autoclave to create a permanent bond.

▶ Rubber-Lined Pickling Tanks

Rubber-lined pickling tanks produced by the Goodyear Tire and Rubber Company are being used in a 391-ft pickling line under construction for United States Steel's Tennessee Coal and Iron Division at Fairfield, Ala.

The high-speed pickling unit for removing surface scale and rust from steel will have a maximum speed of 1000 fpm. The steel tanks, covers, duct work, walkways, fume scrubbers, blowers, exhaust stack, and side guides were fabricated of steel and are being lined with acid-resistant Trioweld, a three-ply course of specially compounded rubber.

The rubber is applied to every portion of the unit which might come in contact with the corrosive acid or its fumes. Each section is then vulcanized in a giant autoclave to create a permanent bond of the lining to the steel and to insure maximum chemical resistance.

When the rubber-lined tanks are welded together and field-sealed at the plant, 12 in. of acid-brick sheathing will be placed on the inside walls and bottom to give added protection against physical abuse and the elevated temperature of the acid solution.

▶ Cunisil-837 Alloy

The American Brass Company, Waterbury, Conn., announces production of Cunisil-837—97.50 per cent Cu, 1.90 per cent Ni, and 0.60 per cent Si. Cunisil is a high-strength, corrosion-resistant alloy that includes many of the desired qualities of silicon bronze or Everdur.

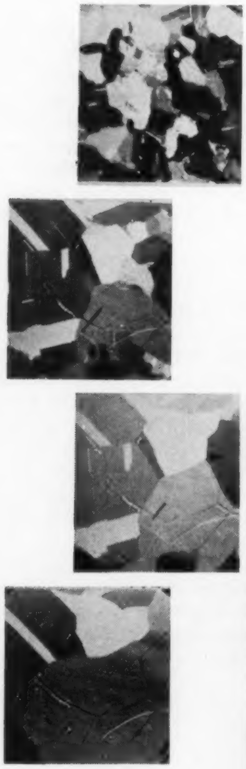
It has a high tensile strength (90,000 psi min), high yield strength (70,000 psi min at 0.5 per cent extension under load), high electrical conductivity (30 to 42 per cent International Annealed Copper Standard as heat-treated), high corrosion resistance, and excellent cold-forming characteristics before the hardening heat-treatment. Compared with Free-Cutting Brass Rod at 100, its machinability rating is approximately 40. It has a density of about 0.322 lb per cu in., and its coefficient of thermal expansion per deg from 68 to 573 F is about 0.0000098.

PHOTO BRIEFS

M. BARRANGON

Dimpling Tool. Boeing developed this light, hydraulically operated tool, in which a split-nut-collet-chuck engages threads on a mandrel—a clamping force in one direction, a forming force in the other. This eliminates the need to remove airframe skins before final assembly, as required by C-yoke dimplers.

Hot Microscope. For observing metals at high temperatures, General Motors has this thermionic-emission electron microscope. Metal samples magnified to 3000× can be seen continuously and "live" as they are heated in a built-in furnace. See changes in microstructure **at left.**



Steel sample (SAE 1080) observed from 1800 F **(top)** to 1950 F **(bottom)**

Ten-Microinch Finish. These are hard-surfaced (Colmonoy #6) plungers for glass-bottle molds, and they can be used just as they come from the lathe of Overmyer Mould Company, Winchester, Ind. A LeBlond, dual-drive lathe with constant surface speed, and a cast-iron-grade, carbide-tipped tool, produce a stepless surface. Commonly, a 10-microin. finish would require secondary polishing.

Ceramic Materials for Tools. Two ceramic powders have been developed by Corning Glass to make tools, jigs, and fixtures for the aircraft and missile industry. Named Corcast and Cortamp, they withstand heat and pressure in forming exotic metals. Expansion coefficients are practically zero.

Anti-Echo Room. At Republic Aviation's $14-million Research and Development Center at Farmingdale, L. I., this anechoic chamber is for investigation of antenna performance in aircraft and spacecraft, without external interference from radio waves. Walls are lined with radio-wave-absorbing materials, and the bulges minimize reflections. Signals will be beamed at scale models of aircraft and space vehicles and antennas while they are remotely rotated.

Engineering Progress in the British Isles and Western Europe

J. FOSTER PETREE
European Correspondent

EUROPEAN SURVEY

Automatic Line-Following Truck

AT THE recent Mechanical Handling Exhibition in London, England, Conveyancer Fork Trucks Ltd., of Warrington, in conjunction with Hunting Engineering Ltd., Luton Airport, Bedfordshire, showed a fully automatic battery electric platform truck with novel features.

For some time the Conveyancer Company has been marketing the "Robot Tug" type of truck, which follows an electrified leader cable laid on or buried in the floor on which it runs. This new truck goes a stage farther and dispenses with the cable. It is fitted with photoelectric cells by means of which it can follow a white line painted on a dark floor or a black line painted on a light-colored one. Moreover, it has a "proximity detector," which causes it to slow up when it comes within about 6 ft of an obstruction. At a distance of 2 ft from the obstacle it stops and will remain stopped for about a minute, blowing a horn loudly to attract attention. If the obstruction is not removed by then, a delay switch shuts off the current completely, after which the truck must be restarted by hand control.

It also has a "command switching panel" that will store commands (for example, "Forward," "Slow," "Wait," "Steer Right," "Steer Left") and act upon them in order when the appropriate signals are received by means of markings on the floor at specified points. Route setting can be done by simple switching, by tablets that operate switches, or by means of punched cards. These assume fairly permanent routes, but if an alteration must be made quickly, this can be done by sticking down adhesive tape. The truck has a platform 66 in. long by 36 in. wide and a wheelbase of 33 in. It will carry a load of 1 ton at $2^3/_4$ mph or $1^3/_8$ mph on a level floor, has a turning circle of 11 ft 2 in. minimum diam, and will climb a gradient of 1 in 25.

This automatic driverless truck, made by Conveyancer Fork Trucks Ltd., follows a line painted on the floor, and slows to a stop when it senses an obstacle

Diesel Pullman Trains

THAT practical and discontented visionary, George Mortimer Pullman, would assuredly admit that he had been outvisioned if he could see the new diesel-electric Pullman trains that have gone into service on some of the mainline British railways.

For a start, five trains have been built: Two trains of six cars each, for first-class passengers only, and three trains of eight cars each, carrying both first-class and second-class passengers. Each six-car train consists of two motor cars, having saloons for 12 passengers; two kitchen cars, with nonsmoking saloons for 18 passengers; and two parlor cars, each seating 36 passengers.

The eight-car trains have similar accommodations, but with additional seats in the motor cars, and two more parlor cars for second-class passengers. The six-car trains seat 132 first-class passengers; the eight-car trains, 108 first-class and 120 second-class passengers.

All the cars are fully air conditioned, with controllable temperature and humidity—the first trains in Britain to be so equipped—and are heavily insulated against sound and outside variations in temperature. The windows are double-glazed, with adjustable Venetian blinds between the two panes of glass. The seats, of aircraft type, are adjustable for angle and for distance from the tables, in the first-class cars. In the second-class, they are fixed. Rubber seals cover the outsides of the gangways between the cars.

The trains have been built by the Metropolitan-Cammell Carriage and Wagon Company and are mounted on Metro-Schlieren all-welded four-wheel bogies. The power equipment was supplied by the General Electric Company Ltd. of England, each unit consisting of a 1000-hp pressure-charged 12-cyl V-type engine of M.A.N. design, made by the North British Locomotive Company and driving a single-bearing combined main and auxiliary generator.

At 1500 rpm the main generator has a continuous rating of 650 kw, at either 1700 amp and 383 volts or 1250

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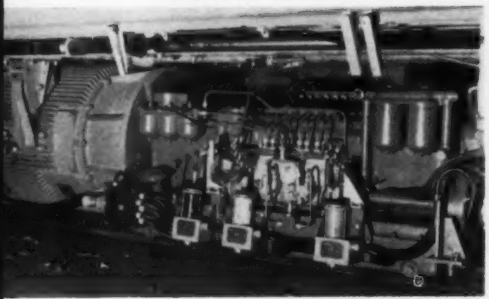


One of the diesel-electric Pullman trains being introduced into the British Railways system. At left is the underslung diesel alternator unit for auxiliary power.

amp and 523 volts. The 10-kw overhung auxiliary generator supplies excitation for the main generator and current for battery-charging, compressor and oil-pump motors, cab heating, and so forth.

The four-pole self-ventilating traction motors are eight in number for both the six-car and the eight-car trains, there being two on the inner bogie of each power car and two on the adjacent bogie of the car coupled to it. They run at 1360 rpm and give 199 hp each. The gear ratio is 19:67, and the connection to the axles is through a Brown-Boveri spring drive, in which a short quill shaft is clamped to the motor frame on the driving side. The driving axle passes through the quill and a gearwheel rotates in roller bearings on it. Flexibility between the gearwheel and the driving axle is provided by a spider pressed onto the wheel hub and projecting inside the gearwheel, with coil springs between to transmit the torque. The maximum speed of the trains is 90 mph.

Auxiliary power for train lighting and for operating the Stone-Carrier air-conditioning equipment is supplied by two underfloor diesel alternator sets, one under each of the two cars adjoining the power cars at the ends of the train. The engine is an 8-cylinder four-stroke Rolls-Royce, type C8NFLH, naturally aspirated and with direct injection, and has an output of 190 hp at 1500 rpm. It drives a 150-kva Stones Tonum alternator through a flexible coupling. The cylinders are $5^1/_8$-in. bore and 6-in. stroke, and the compression ratio is 16:1.

The controls enable the unit to be started, to run at idling speed, and be stopped from the side of the track, or be started, run at full rated speed, and be stopped from within the car. To ease the load at starting, there is a time delay in the air-conditioning control circuit of each car that can be set to give any delay between about 5 sec and 1 min; thus by setting the dials in the cars differently, the equipment throughout the train can be started in sequence instead of simultaneously. On a recent demonstration run, the smooth, quiet traveling, and rapid acceleration to the full speed of 90 mph were all that was claimed for the new trains; but it is likely to take a little time to educate the British traveler to air conditioning, a luxury to which he is not accustomed. A few fans disposed about the cars would probably help.

Future of Nuclear Power

The capital cost of atomic power stations under construction in the United Kingdom is coming down appreciably, according to Sir Christopher Hinton, chairman of the Central Electricity Generating Board. He spoke at the Tercentenary Celebrations of the Royal Society, which was founded in London in 1660. Of five stations now building, Berkeley, with a capacity of 275 mw sent out, would cost the equivalent of $450 per kw; Bradwell, a 300-mw station, would be slightly less; Hinkley Point (500 mw) would come out at about $370, and Trawsfynydd (500 mw) at $345; but Dungeness (550 mw), the most recently ordered, was expected to cost no more than $310 per kw sent out. Research and development costs, however, were still very high, and, even in another 15 years, were unlikely to be less than six times the current costs of improvement of conventional thermal power plants.

Correction

In the description of the Jünkerather hot-metal mixer on page 67 of the July issue of Mechanical Engineering, the axle loading should have been $28^1/_2$ metric tons instead of $2^1/_2$ metric tons.

Substance in Brief of Papers Presented at ASME Meetings

ASME TECHNICAL DIGEST

Heat Transfer

The Heat-Balance Integral—Further Considerations and Refinements..60—SA-9 ...By T. R. Goodman, Allied Research Associates, Inc., Boston, Mass. 1960 ASME Summer Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to April 1, 1961).

The heat-balance integral mentioned in the title is an integral of the transient heat-conduction equation in a solid and is analogous to the momentum integral in boundary-layer theory.

Integral methods have previously been applied to transient heat conduction in a slab with constant thermal properties.

In this paper the method is extended so as to include temperature-dependent thermal properties in the analysis. In addition, it is shown how to improve the accuracy of a solution by increasing the order of the polynomial used to represent the temperature profile. For the case of a prescribed step surface temperature in a semi-infinite slab, a quartic profile is shown to give excellent accuracy.

Some Temperature and Pressure Measurements in Confined Vortex Fields.. 60—SA-4...By J. M. Savino and R. G. Ragsdale, Lewis Research Center, NASA, Cleveland, Ohio. 1960 ASME Summer Annual Meeting paper (in type; to be published in **Trans. ASME—J. Heat Transfer;** available to April 1, 1961).

Studies were conducted on vortex flow generated within two right circular cylinders by injecting air through longitudinal vanes forming the chamber. The length-to-diameter ratios were 0.107 and 0.50. Experimental end-wall static pressure distributions, some total pressures, and total temperature data are presented.

The most significant finding was the large radial variations in the total temperature; this is related to the Rangue-Hilsch effect.

Also discussed is the relationship between the static wall pressures and the effective velocities in the vortex.

The static wall pressure measurements indicate that the effective tangential velocity increases as the air moves in from the cylinder circumference toward the exhaust hole and then sharply changes to a flow similar to wheel-type motion within the exhaust hole circle.

Transient Heating of Two-Element Slabs Exposed to a Plane Heat Source..60—SA-14...By Henry Halle, Assoc. Mem. ASME, and D. E. Taylor, The University of Chicago, Chicago, Ill. 1960 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1961).

In applications where materials are to be employed as heat sinks, knowledge of the influence of thermal properties on the transient heat-storage characteristics of different materials is important to the designer.

In a two-element heat sink, an external layer (meaning the layer directly exposed to the heating) which will resist high temperatures may be combined with an internal layer which may also serve structural purposes. In such a case the designer is faced with the problem of how best to combine the materials in his application, i.e., what relative thicknesses to employ.

A method has been devised which quickly provides design information regarding the thermal behavior of two-element slabs. It is applicable to situations where materials are exposed to heating which may be reasonably approximated by a one-dimensional heat flow characterized by a constant heat-flux rate at one surface and by perfect insulation at the other surface.

The results of analytical solutions are presented in the form of a series of charts which demonstrate the interrelationships between the many variables. These charts also provide a computational aid for design purposes.

General information is presented concerning the maximum heat-storage capabilities of materials used as single slabs, the manner in which materials must be combined in order to achieve higher heat-storage capabilities with two-element slabs, and the behavior of the ratio of the maximum temperatures rise at the interface between the two elements of the slab.

Machine Design

Two-Stage Planetary Arrangements for the 15:1 Turboprop Reduction Gear.. 60—SA-1...By E. A. Brass, Assoc. Mem. ASME, AVCO Corporation, Stratford, Conn. 1960 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1961).

The increasing interest in the small gas turbine for propeller-driven aircraft has created a need for lightweight, compact, high-efficiency transmissions with a speed reduction ratio of 15:1 or higher.

Small gas turbines to operate efficiently must have high rotor speeds. Generally, the smaller the horsepower class, the higher is the rotor speed. The trend in propeller design is toward larger and hence lower speed propellers; this then results in speed ratio requirements of 15:1 and higher for small turboprop engines.

The romance of the small gas-turbine engine is its ability to develop 4 or 5 hp per lb of basic engine weight. The primary concern of the transmission designer is to provide a reduction gear which will deliver this power to the propeller at a useful shaft speed with a minimum of added engine weight. To complicate this problem further, the reduction gear must be both compact and efficient.

Within the limitations of this analysis the split-power, two-stage planetary arrangement offers the best solution to the 15:1 turboprop reduction-gear problem. A description is given of different two-stage planetary arrangements and the actual layout of the split-power transmission.

On the Use of Clearance in Viscous Dampers to Limit High-Frequency Force Transmission..60—SA-17... By M. E. Gurtin, General Electric Company, Schenectady, N. Y. 1960 ASME Summer Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to April 1, 1961).

Viscous damping is effective in limiting the resonant force transmission of a single-degree-of-freedom system. However, the force transmitted to the foundation at frequencies much higher than the resonant frequency increases with increasing damping.

A method which may be used to overcome this difficulty is the intentional use of clearance in the viscous damper. When the amplitude is high, which is the case at resonance, the damper acts to dissipate energy.

However, when the amplitude is low, as is true at frequencies much higher than the resonant frequency, the damper is inactive and the force transmitted to the foundation is low. This study determines the parameters involved in designing a system such as this.

The results show that the clearance damper combines the low resonant-force-transmission feature of the viscous-damped system and the characteristic of low force transmission at high frequencies of the undamped system.

Analysis and Design of Tangent Elasticity Vibration Isolators..60—SA-5... By J. E. Ruzicka, Assoc. Mem. ASME, Barry Controls, Inc., Watertown, Mass. 1960 ASME Summer Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to April 1, 1961).

The resilient member of a vibration isolator may have a load-deflection characteristic that exhibits an increase in static stiffness with an increase in applied load or deflection. This nonlinear stiffness property is characteristic of rubber in compression and of conical compression springs. In determining the natural frequency and deflection of an isolation system employing a nonlinear vibration isolator, any nonmassive loading that exists must be taken into consideration.

In the paper, general solutions are obtained for the natural frequency and deflection of hardening vibration isolators that fall into the "tangent elasticity" class of nonlinearity for the case of small harmonic motions about the loaded equilibrium position.

A procedure is developed for the minimization of the natural frequency and the determination of certain properties of an isolator for which a load-deflection curve is available. This procedure is applied to the design of conical compression springs as well as rubber compression isolators.

Process Industries

Development of a Prototype for a Large Electrodialysis Cell for Treating Brackish Waters..60—SA-27... By H. R. Drew, Texas Electric Service Company, Fort Worth, Texas. 1960 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1961).

A rapidly growing area in West Texas that received little rainfall looked beyond its fully developed fresh-water resources for future supplies.

The subsequent development of the first prototype for a single-cell high-capacity electrodialysis plant for purifying saline underground and surface water is discussed.

The process, which is relatively new, uses electrodes to attract the salt ions, and permeable membranes to strain them from the "product" water.

Four units were installed for observation purposes near Wichita Falls, Texas. Three of these were subsequently transferred to regular operating conditions, where they have been for a year.

Knowledge gained by observing the units in operation is presented, including cost equations and limiting factors of the cell structure.

Although the process is expensive now (a small installation at Coalinga, Calif., produces fresh water for \$1.45 per 1000 gal), it is felt that, with improvements in design, large-scale plants of the future will be capable of producing potable water for costs around 30 to 50 cents per 1000 gal. Although still high, these costs will compare favorably in the future.

Petroleum

A Floating Vessel Drilling and Multicompletion Method..60—SA-39... By David C. Guinn, Shaffer Tool Works, Houston, Texas; and Raymond W. Walker, Shaffer Tool Works, Brea, Calif. 1960 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1961).

A method of drilling and completion of an oil well from a floating vessel permitting ocean-floor installation of wellhead equipment is completely feasible employing features currently being used on drilling and production assemblies.

In 1953, when the first conventional unitized rotary drilling machine was set aboard the MV Submarex (Surplus Navy PC, 176 ft long), several techniques were employed in setting casing and drilling rotary holes in the ocean floor. Problems of drilling-mud circulation, bit changes, and pressure-control methods were overcome by using forms of conventional drilling equipment. Specialized forms of equipment were also designed and used with varying degrees of success in an effort to overcome some of the inherent problems related to this type of drilling. One such piece of equipment, a subsea drilling head, is described, and types of guide systems and latching devices used to engage the drilling equipment to the casing strings on the ocean floor are briefly discussed.

By 1956 several floating-vessel drilling rigs were commissioned and in operation by different major oil companies. One such vessel and its operation in water depths from 63 to 110 ft in the Gulf of Paria, Trinidad, B.W.I., are described.

The authors discuss the economics of floating-vessel operation for exploratory and development drilling, noting that drilling in water depths of 100 ft and greater appears to establish a point of greatest saving.

Some basic operational techniques that have developed during the past several years of subsea drilling, with the steps necessary for setting a multistring subsea Christmas tree, are described in the following order: (1) Securing the vessel and running starting base. (2) Running the conductor casing. (3) Drilling the surface hole. (4) Running the surface casing. (5) Installing blowout preventers and drilling ahead. (6) Running and hanging the production string. (7) Completing and testing.

An Analysis of the Yielded Compound Cylinder..60—SA-13... By S. J. Bocker, Westinghouse Electric Corporation, Pittsburgh, Pa. 1960 ASME Summer Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to April 1, 1961).

It is possible to examine the stress distribution and deflections in the yielded cylinder theoretically to discover what the true strength of the vessel is and what benefit can be achieved from a measured amount of pressure that will cause partial yielding.

There are several answers to the question of strength, depending on exactly the meaning assigned to the term strength, but that the question of benefit from partial yielding has an essentially unique and unusually simple answer.

An analysis is made of the partially plastic range, restricted to plane strain, of the compound cylinder, made by shrinking together many concentric cylinders. An example is given using, for ease of illustration, a cylinder designed to yield simultaneously in all its components.

A comparison is made between a structure with a compressible elastic material and one with an incompressible elastic material. Finally, an important autofrettage formula is developed.

Stresses in Thin-Walled Pressure Vessels With Ellipsoidal Heads..60—SA-12... By H. Kraus, Assoc. Mem. ASME, G. G. Bilodeau, and B. F. Langer, Fellow ASME, Westinghouse Electric Corporation, Pittsburgh, Pa. 1960 ASME Summer Annual Meeting paper (in type; to be published in **Trans. ASME—J. Engng. for Indus.**; available to April 1, 1961).

A finite difference approximation to the Love-Meissner equations for the ellipsoidal shell was used to calculate stress in thin-walled pressure vessels with ellipsoidal heads. Calculations were made with a digital computer for a useful range of the shell parameters.

Results are reported in the form of stress indexes and stress intensity indexes, the latter based on the maximum shear theory of failure. Comparisons are made with the available experimental and analytical work in the literature, and stresses are also given for typical heads designed in accordance with the ASME Boiler and Pressure Vessel Code.

Management

A Method for Determining the Optimum Starting Quantity When Manufacturing to Fixed Order Size..60—SA-29... By Henry P. Goode and S. Saltzman, Cornell University, Ithaca, N. Y. 1960 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1961).

In many manufacturing situations, parts are produced to meet exactly, or within close tolerances, the quantity ordered by a customer. Production of these parts, however, may be by manufacturing processes in which there is a probability of loss due to spoilage of parts during processing. Under these conditions, the manufacturing process must be started with more than the required number of parts to complete the order so there will be a reasonable expectation of finishing the process with the required number of satisfactory parts.

The problem discussed is that of determining starting quantities for production runs so as to minimize the sum of the costs. The method discussed begins with the determination of the cost to be incurred and the optimum number to start through the process when the required order quantity is only one item, then two, and finally three.

If this approach to the starting-quantity problem is found of use and interest, plans are to prepare much more extensive tables through use of a stored-program high-speed computer.

Managing the Professional Employee..60—SA-28... By William J. Jaffe, Assoc. Mem. ASME, Newark College of Engineering, Newark, N. J. 1960 ASME Summer Annual Meeting paper (multilithographed; available to April 1, 1961).

The term "professional" is often applied to occupations that lack the elements of professionalism, namely, a body of specialized knowledge, a period of training and study, and compliance with a standard code of ethics.

Today's professional employee, in addition to obeying the ethics of his professional group, must also adhere to practices set down by his employer. To achieve such adherence smoothly, he may require special managerial techniques.

His position in relation to his unprofessional managers is discussed, as well as the position of the manager who must occasionally make professional decisions. In conclusion, it is thought that the manager of a professional employee should himself have once been a professional.

Aviation

The Navy Approach to the Development of Airframe Structural Design Control Requirements..60—Av-50... By W. H. Keen, R. L. Creel, and C. P. Baum, Bureau of Naval Weapons, Department of the Navy, Washington, D. C. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

Design requirements control, to a large degree, the success or failure of a weapon system. Requirements for design control of airplane structures are strongly rooted in an accumulation of performance experience, but constant refurnishing and extrapolation are necessary to match the onrush of scientific advance.

The structural design control the Navy exercises over planes embraces the specifications that define airplane strength and rigidity as well as analyses, tests, and data requirements needed to insure attainment of suitable structures. In addition, it includes those engineering design efforts which extend throughout the development phase, early testing and demonstration, introduction into the Fleet, service operation, and ends only upon retirement of the airplane—a cradle-to-the-grave concept.

Within its capabilities, the Navy stresses the continuing assessment and measurement of operating loads and environment for structural requirements, synthesizing them for expression in engineering terms in design specifications and contracts; and demonstrating the degree to which requirements have been met. A last but important link in the design-control process is that of using service feedback to correct unforeseen deficiencies in the hardware and specifications.

Maintenance Experience With Boeing Gas Turbine Engines..60—Av-41... By Daniel F. McGrath, Industrial Products Division, Boeing Airplane Company, Seattle, Wash. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

Introduction of the Boeing Model 502 gas turbine into customer service eight years ago presented new and unique problems in engine maintenance.

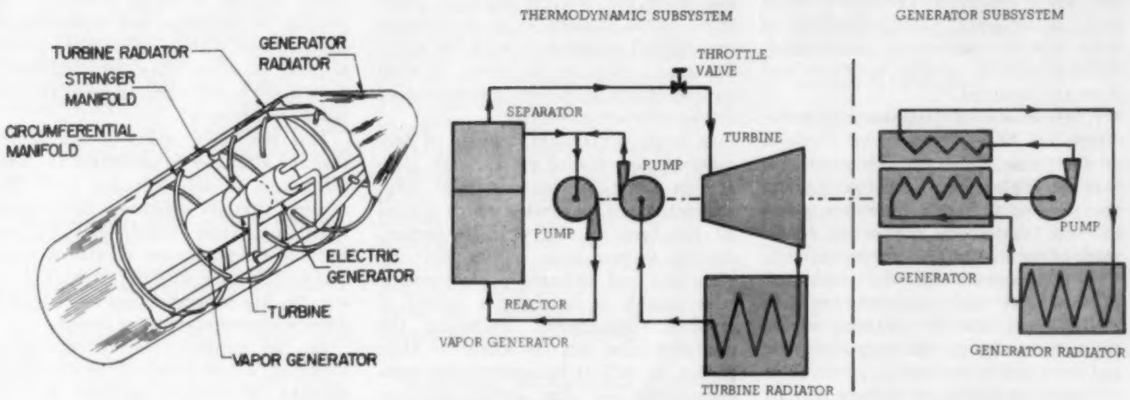
The Boeing Model 502 is a small gas-turbine engine in the 150–360-hp class. It is currently being produced in two basic configurations: A shaft-output engine and an air-compressor engine. An important feature of the Model 502 is that both turbine rotors are supported by floating bearings only, providing enough radial freedom to the rotor to allow it to spin about its mass center rather than its geometric center.

To insure optimum performance and service life of this new engine, a program of preventive maintenance was developed so that minor troubles could be detected before they caused unscheduled outages.

The critical components in the hot-gas flow are periodically inspected. Problem areas include the burner dome, first-stage turbine wheel, gas producer nozzle box, nozzle ring, air-flow controller, and starter difficulties. These are reviewed, and the corrective action resulting from maintenance experience is described.

Optimized Condenser-Radiator for Space Applications..60—Av-16... By Paul C. Holden, Westinghouse Electric Corp., Drexel Hill, Pa.; and Francis C. Stump, Westinghouse Electric Corp., Lima, Ohio. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

The waste-heat radiator is an extremely important component in a space electrical power system. It is by far the bulkiest



A concept of the physical arrangement of the significant components in the electric power system discussed for use in space vehicles is shown **at left. At right** is a block diagram of the system. For evaluation purposes the system has been split into two subsystems, and shows only those components with weight significance. (60—Av-33)

component in the system and is often the heaviest.

The radiator for a Rankine-cycle turbogenerator system, which promises to have a wide range of application in space, is of particular interest. This system requires condensation of the cycle working fluid. In the simplest case, which is the one discussed, this is accomplished directly in the radiator.

The major problems connected with the design of fluid-carrying waste-heat radiators for space are the transfer of heat and protection from disability by meteoroid puncture. A cylindrical radiator with a finned-tube surface seems satisfactory.

The basis and results of a study of a condenser radiator for application in space are presented. An optimized relationship for design factors considered is established for the configuration studied, and results are given over a range of power levels.

Space Electric Power Application Study..60—Av-33... By H. B. Saldin, Mem. ASME, Westinghouse Advanced System Planning, Drexel Hill, Pa.; and N. F. Schuh, Aircraft Equipment Department, Westinghouse Electric Corporation, Lima, Ohio. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

Space vehicles must have electric power to receive commands, to perform guidance functions, to explore space, to transmit information back to earth, and, if they are manned, to sustain life aboard the vehicle. But a space electric power system represents a large part of the payload weight and as much as 30 per cent of the total cost of the vehicle.

A study was undertaken to determine the optimum power source to meet space-vehicle requirements.

Types of power systems are discussed and it is concluded that the nuclear reactor appears to be the only feasible energy source for the high power and long-life systems. The turbogenerator is selected to illustrate the method of analysis, and the reasoning is presented behind the respective choices for the system of the Rankin cycle, maximum cycle temperature of 2500 R, sodium as a working fluid, and the single-loop (direct cycle) system.

Definitions are given of the characteristics of the various major components in the system in terms of the variables that affect weight. They include the vapor generator, turbine, generator, and the three pumps required. A companion paper, which discusses the radiators, is Optimized Condenser-Radiator for Space Applications, by P. C. Holden and F. C. Stump (60—Av-16).

The complete system optimization, exclusive of power-utilization equipment and shielding, is then discussed by systematic trading of the effects of the various design factors on other components of the system. Tables on the design factors and weight of major components are included.

Barometric Altitude—the Problem, Solution, and Altimeter Design..60—Av-43... By R. A. Cooper, AiResearch Manufacturing Company, Los Angeles, Calif. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

This paper reviews the problem of altitude measurement in the range of sea level to 80,000 ft and briefly discusses several methods and design approaches leading to improved accuracy levels.

A new altimeter design is disclosed which is not dependent upon aneroid-element deflection, and details of the mechanization are discussed.

The influence of static-system errors is considered, with equipment designs described for error compensation.

In presenting designs for equipment and systems capable of improving measurement of barometric altitude, the paper concludes that their availability will result in airspace vertical separation changes and increased airspace utilization.

A Systems Analysis of Fast Manned Flights to Venus and Mars..60—Av-1... By Krafft A. Ehricke, Convair Astronautics, San Diego, Calif. 1960 ASME Aviation Conference paper (preprint; to be published in **Trans. ASME—J. Engng. for Ind.;** available to April 1, 1961).

The launching of each instrumented probe into interplanetary space prepares the way for manned ventures.

The first part of a systems analysis for the initial manned venture is outlined. For this purpose, the years 1970–1973 are assumed as target period for the first manned Venus and Mars flights. By that time considerable experience will have been gained in the course of manned lunar operations (1965–1970), nuclear heat-exchanger engines will have been developed (1959–1965) and operated in space (1965–1970). Long-term orbital flight testing of crews, their life support system and other vital components will have been conducted in satellite test facilities (1963–1970), and nuclear energy will have become available in electrical systems for many purposes ranging from auxiliary power supply to low thrust nuclear-electric drives.

The primary objectives of the first missions are specified and the mission

philosophy discussed, in order to set a frame of reference. The importance of brief mission periods is emphasized. Suitable mission profiles to Venus and Mars are presented.

A discussion of propulsion systems, which can be expected to be available at that time, leads to the conclusion that the nuclear heat-exchanger system, operating with liquid hydrogen, offers the best compromise within the framework of the mission philosophy outlined. The requirements for the ecological payload and the supporting systems are discussed, and the resulting weight requirements for the life support system and the scientific payload determined.

Finally, a prototype layout for fast manned reconnaissance vehicles is presented.

Temperature Control System for the Atlas Able-4 Lunar Satellite..60—Av-46... By R. M. Acker, R. P. Lipkis, and J. E. Vehrencamp, Space Technology Laboratories, Inc., Los Angeles, Calif. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

The need to control the mean internal temperature of the Atlas Able-4 lunar satellite within the range of 45 to 70 F led to the development of an active, lightweight closed-loop temperature-control system.

The system senses internal temperatures and alters the effective radiation properties of the satellite so as to maintain the internal temperature with the specified range, even in the event of some adverse effects of the space environment on the radiation properties.

In brief, the system consists of fifty rotatable four-bladed masks, each actuated by a spirally wound bimetal strip; the rotation of the masks (which control 20 per cent of the satellite surface) exposes surface areas having differing absorbing and emitting characteristics. It is capable of satisfying a variety of mission requirements, including the changing solar flux for Venus or Mars probes, as well as accommodating some degradation of the surface-radiation properties due to long exposure to the stresses of the space environment.

The way in which these problems were met is discussed.

A New Fail-Safe Compensated Altimeter ..60—Av-45... By Walter Angst and James Angus, Assoc. Mem. ASME, Kollsman Instrument Corp., Elmhurst, N. Y. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

Constantly increasing air traffic is placing more and more aircraft in a given airspace at a given time. For economic reasons, the flight levels of modern aircraft are crowded into relatively narrow bands of altitudes. To provide for minimum safe separation of these aircraft while at their flight levels, as well as when they are "stacked," more flight levels within a given altitude range are necessary.

This not only makes it mandatory that the altimeter be calibrated to closer tolerances at all altitudes, but also requires that its indication be compensated for errors contributed by the static pressure system of the aircraft. Static errors vary with the attitude of the aircraft, Mach number, and altitude, and differ with various types of aircraft.

As the foregoing errors cannot be tolerated, a new approach to the measurement of pressure altitude is now offered.

This scheme makes use of a basic precision altimeter which is overpowered by a simple servo to present compensated pressure-altitude as determined by an air-data computer. Any typical altimeter display may be used with this approach. By using a basic pressure altimeter as the heart of the instrument, the over-all reliability of the instrument is vastly increased, since, in the event of a servo failure, the instrument inherently reverts to stand-by operation.

Viscous Shear Torque in Floated Gyroscopes..60—Av-47... By J. F. Bellantoni, Sperry Gyroscope Co., Division of Sperry Rand Corp., Great Neck, L. I., N. Y. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

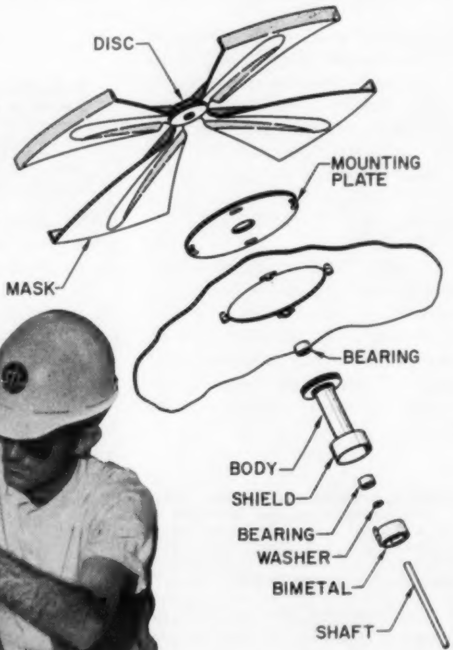
The accuracy of present-day inertial-guidance systems depends to a considerable extent upon the performance of the floated gyroscopes that provide the inertial reference.

Among the thermal effects that contribute spurious drift torques in such gyroscopes is the presence of free-convection currents in the flotation fluid. These currents tend to arise from any temperature distribution within the fluid in which the horizontal component of the gradient is not zero.

In most cases the currents result in a net torque exerted on the floated gyro, causing drift. It is desirable for the engineer to know the approximate magnitude and direction of the torque and how they can be minimized in the design of the gyro.

A method is presented for approximating the viscous shear torque due to thermally induced currents for arbitrarily shaped containers taken in three dimensions. Calculation results for the cylindrical and spherical cases are given.

It is shown that, whatever the shape of the containing gimbals, as long as the shapes are similar and the space between them is small compared to



An exploded view, **right**, shows the temperature control unit used on the Atlas Able-4 lunar satellite. A rotatable, four-bladed mask is actuated by a spirally wound bimetal strip that senses internal payload temperature. A worker, **below**, installs the unit on the Able-4 payload. (60—Av-46)

their diameter, the total torque vector on the gyroscope in the steady state may be approximated from the temperature distribution within the fluid. The results, therefore, are applicable to many, but not all, practical gyro designs, particularly those of one degree of freedom.

Determination of the In-Flight Vertical..60—Av-44...By C. E. Barkalow and H. C. Daubert, Lear, Inc., Grand Rapids, Mich. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

A continuous and accurate knowledge of the direction of the vertical is of extreme importance to the safe and proper operation of today's high-speed aircraft. Gyroscopes and gravity sensors, in combination, are the fundamental building blocks of vertical reference systems used to determine the ertical during flight.

The factors affecting in-flight vertical accuracy may be classified as follows: (*a*) Acceleration effects, (*b*) geometric effects, (*c*) gyroscopic effects, and (*d*) coupling effects.

Some of the methods, both past and present, for attaining improved in-flight vertical accuracy include:

1 Inclined-axis method of vertical gyro turn compensation.
2 Rate of turn erection cut-off method.
3 Fore-and-aft erection cut-off method.
4 Roll-angle cut-off method.
5 Pitch-bank erection method.
6 Additive-signal method.
7 Velocity-aided torque balance pendulum system.
8 Schuler tuning method (inertial).

If a particular flight regime is specified, the performance of any vertical reference system can be determined by computation beforehand, thus providing a realistic basis for selection of a system compatible in accuracy with the other systems with which it is to operate.

A Self-Stabilizing Gyro Control System for Space Vehicles..60—Av-51...By Sidney Godet, Reeves Instrument Corp., Roosevelt Field, Garden City, L. I., N. Y. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

In many applications for satellites and space vehicles, it is necessary to maintain the vehicle either in a fixed orientation, or rotating at some known rate, with respect to inertial space. In order to achieve this control it is necessary (*a*) to provide means for sensing the inertial rate or position of the vehicle, and (*b*) to provide means for changing these quantities in response to the sensing outputs.

A control system is described wherein three single-degree-of-freedom gyros are arranged in a novel configuration such that the self-stabilizing properties of the gyros are utilized without producing any oscillatory effects.

The carrying vehicle is automatically maintained stationary in inertial space in the presence of external disturbing torques. Also, electrical signals are generated which indicate how much of the momentum capability has been used. In another mode of operation, the same gyros are connected as inertial rate sensors with electrical outputs.

Possibilities for Simulation of Dynamic Physiology..60—Av-35...By A. J. Gold, General Electric Missile and Space Vehicle Department, Philadelphia, Pa. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

Computer technology offers the dynamic biologists the opportunity to make new discoveries by means of the sophisticated simulation of living systems.

A brief description of homeostasis, the complex self-regulating system that maintains the stability of the body's internal environment, is first presented. The body's acid-base mechanism, a major subdivision of the system, is analyzed and the possible application of computer techniques for an assessment of the mechanism is discussed.

The computer is finally treated with respect to its application to the study of a variety of physiological processes.

Possibilities for Human Simulation..60—Av-37...By A. Ben Clymer, Mem. ASME, North American Aviation, Inc., Columbus, Ohio; and Albert F. Ax, Lafayette Clinic, Detroit, Mich. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

Possibilities for major advances within the next few years in human simulation by means of analog and digital computers are discussed.

A listing of possible applications for simulation of interacting homeostatic systems, and for simulation in pathology, pharmacology, and military medicine is included.

The blocks in a diagram of a human operator model with decision-making capabilities are also analyzed separately. Conceptual models, only two classes of which exist at present, are necessary in the simulation of higher processes. Both the neural net and the problem-solving classes are discussed.

In conclusion, the obstacles to several areas of human simulation are presented. The authors also address a plea to workers now engaged in human simulation to recognize its inherent unity as an applied scientific area.

Simulation of Human Physiological Systems..60—Av-38...By R. W. Stacy and N. A. Coulter, Jr., The Ohio State University, Columbus, Ohio. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

Simulation has long been used in the study of living systems. In this paper, many uses of simulation are discussed, including the simulation of components of living systems by nonliving elements, the use of equations to describe the behavior of living systems, the application of feedback-control-system theories and techniques to the study of biological control systems, and the simulation of the mental processes of medical diagnosis by computers.

The usefulness of computers as simulators of living processes is pointed out, and further applications are predicted.

Performance of the Ducted Rocket..60—Av-25...By Rudolf R. Kassner and Frank W. Gobetz, Rocketdyne Division, North American Aviation, Inc., Canoga Park, Calif. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

Many hybrid propulsion schemes have been proposed with the intention of combining the advantages of the basic propulsion forms. The general class of nonairbreathing-airbreathing hybrids may yield the best solution to many mission problems.

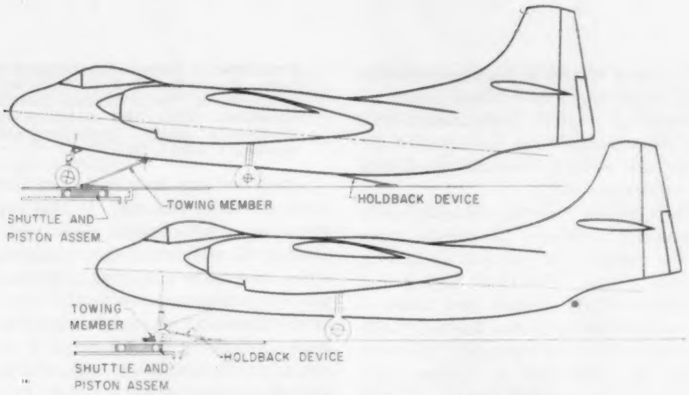
Such a hybrid is the ducted rocket which, in its most general description, consists of a rocket exhausting into an air duct.

The performance limits of the ducted rocket are studied, with primary emphasis being placed on booster application. Some effort has also been directed toward the ram rocket. The effect of aerodynamic mixing on performance is studied separately, using a concept employed by Busemann, and resulting in a flexible method of evaluation, suited for mission studies.

Calculations based on this method, however, yield unfavorable results for the ducted booster rocket. The results indicate that the ducted booster rocket is probably not a practical device for vehicle application, and, as the ram rocket suffers from the weight and drag penalties imposed by the duct, it is concluded that a ramjet in parallel to a rocket may be preferable.

Safety Considerations in the Design of Flight Control Systems for Navy Aircraft..60—Av-34...By W. R. Lomas, Engineering Development Laboratory, U. S. Naval Air Development Center, Johnsville, Pa. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

An important consideration in the design process of flight control systems



The nose tow system of catapulting, below, has been introduced to eliminate many problems inherent in the conventional method, above. Among other improvements, the nose tow method provides for automatic hookup of catapulting accessories. (60—Av-49)

is the safety of the pilot and flight crew.

The rapid growth in complexity of aircraft flight-control systems in the past decade, caused by the rapid expansion of the speed and altitude envelope over which modern aircraft are expected to perform, has placed a heavy burden of responsibility on the designers of such systems to obtain this objective.

The flight-control-system designer is no longer responsible only for the pure mechanical aspects of control systems, but must also now insure the performance and reliability of hydraulic power systems, electrical subsystems, electromechanical and electrohydraulic components, pneumatics, and additional stability augmentation, trim control, and damping devices that compose the integrated flight-control system of current aircraft.

Most of the design installation and test requirements listed in these specifications are there for the purpose of insuring reliable (and therefore safe) control-system performance over the specified flight envelope of the aircraft.

Design procedures and specification requirements essential in achieving safe and reliable flight-control systems for piloted aircraft are discussed. The importance of failure effects, analyses, and functional test stands in insuring safe flight-control systems is emphasized.

Dynamic Loads During Nose Tow Catapulting..60—Av-49...By Warner Lansing, William H. Mueller, James L. Malakoff, and Morton Mantus, Grumman Aircraft Engineering Corp., Bethpage, N. Y. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

Naval air missions depend upon the successful launching of carrier-based aircraft. These launches accelerate the airplane from an at-rest position to flying speed over a relatively short distance. Launch speeds in excess of 100 knots, attained within 250 ft, are not unusual.

The two catapult systems now available, one utilizing hydraulic power, the other steam, both exert force at deck level by means of a towing shuttle.

In the conventional catapulting configuration currently in use, the catapult shuttle applies force to a long bridle (towing member) located at the nose, while the holdback and release assembly is located well aft. But as heavier, high-performance Naval aircraft are placed in service, certain features of conventional catapulting, such as heavy external equipment and the necessity for a deck crew, are becoming undesirable.

To eliminate many of the problems inherent in the conventional method, the nose tow system of catapulting has been introduced. This system provides for automatic hookup of the catapulting accessories. In addition, the towing member is an integral component of the nose gear, while the hold-back and release assembly is attached to the nose strut prior to aircraft arrival at the launching site.

However, the new launching configuration introduces the possibility of unusual structural design problems.

An investigation of the structural dynamic loads for the new system is presented. Specifically, loads computed analytically are compared with those measured in an aircraft during launch from a steam catapult. Comments are made concerning the use of the analytic loads fordesign.

Structural Designers' View of Criteria Trends..60—Av-42...By Robert Goldin, Bell Aircraft Corporation, Buffalo, N. Y. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

Adopting the point of view of the structural designer, available structural criteria are reviewed with respect to the demands for new criteria for a variety of advanced flight-vehicle types. The basic needs of the structural designer are delineated in relation to his specific function of crystallizing the configuration arrangement and element cross-section area details of the structural components.

The nature of the criteria required in design of several new types of flight vehicles is outlined. It is shown that a considerable amount of basic structural criteria is applicable to almost all flight vehicles. A new arrangement for structural-requirement specifications is advocated.

Air Force Maintenance on the J79 Engine..60—Av-48...By John H. Toeplitz, Oklahoma City Air Material Area, Tinker Air Force Base, Okla. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

The Air Force J79 Engine, a high-performance, light-weight turbojet aircraft power plant, has opened new vistas of performance, field maintainability, and overhaul.

USAF experience with this engine is described during development, operation, and the various military levels of maintenance.

Problem areas encountered were: Vibration resulting from an unstable compressor rotor; compressor-rotor-blade vibratory stresses resulting in fatigue-type failures in the first serration of the blade-attachment point; and engine flameout in the afterburner fuel system. Modifications to correct these problems are described.

Propulsion system maintenance is also reviewed as accomplished on three distinct levels, beginning with flight-line maintenance, extending to more elaborate field maintenance, and finally ending in depot level overhaul.

BOAC'S Maintenance Experience of the Rolls Royce Avon Mark 524 in Its Comet-4 Jets..60—Av-22...By J. G. Romeril, British Overseas Airways Corporation, London Airport, Hounslow, Middlesex, England. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

Maintenance and operational experience with the Avon Mark 524 gas turbine, one of the world's most widely used engines of its type, are described.

The chronological development of the Avon family, features of the engine, and plans for vibration detection and temperature-spread observation are outlined.

The author also reviews the fuel system, which is the most complicated part of the engine, and provides a breakdown of reasons for engine removals with remedies suggested by experience.

B. E. A.'s Experience With Propeller Turbine Engines..60—Av-52...By H. G. Rossiter, British European Airways Corp., Engineering Base, London Airport, Hounslow, Middlesex, England. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

The Rolls Royce Trent, the first propeller turbine in the world to fly, was created in 1943, when Rolls Royce Ltd., adapted its current jet engine, the Derwent.

The beginning of the turboprop-powered aircraft era was marked July 16, 1948, with the historic eight-minute flight of the world's first propeller turbine airliner, the Vickers V.630. Two years later on July 29, 1950, British European Airways pioneered the world's first scheduled passenger service from London to Paris.

B. E. A., still the world's largest operator of turboprop aircraft, relates its experience with the propeller-turbine engine. The story starts when the corporation was still in its embryo stage in 1945 and follows the developments from those early project days and Dart/Dakota development flying to Dart/Viscount operation, maintenance, and overhaul.

In its basic form the Rolls Royce Dart is a single-shaft, two-stage centrifugal compressor, two-stage axial-flow turbine engine. The compressors are directly coupled to a double turbine assembly and to the propeller through a compound reduction gear. Between the compressor and the turbine are situated the combustion chambers which provide the motive force for driving the turbine, which in turn drives the compressor and propeller. The controls for engine RPM and fuel flow are interconnected to provide a single-level power control.

The mechanical reliability and overhaul life development of the power unit are discussed, together with some of the problems encountered and the more important development trials conducted.

Maintenance of the Bristol Proteus in BOAC's Britannia Aircraft..60—Av-21...By J. G. Romeril, British Overseas Airways Corporation, London Airport, Hounslow, Middlesex, England. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

Two types of Proteus gas-turbine engines power the largest BOAC fleet of aircraft ever owned by the corporation. Up to January of this year 750,000 engine hours had been accumulated and nearly 51,000,000 revenue miles flown. During this period the Proteus engines achieved an excellent rate of overhaul-life increase. Details of the features of the engine contributing to its outstanding performance are given.

The operation of the two basic control systems, the power control system, and the propeller control system are described, and the maintenance requirements for the engine are presented.

Theoretical and Experimental Investigation of a High Performance Jet Pump Utilizing Boundary-Layer Control..60—Av-15...By William Graham Wells, Mississippi State University, State College, Miss. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

A jet pump, or ejector as it is often called, is a device in which part of the kinetic energy of one fluid is transferred by viscous shear and by turbulent mixing to a second fluid, this secondary fluid being, to a greater or lesser degree, either accelerated to a higher velocity or pumped to a higher pressure. The jet pump may act as a blower, a pump, or a thrust augmenter, all of which find unique application in aircraft.

By examining the processes through which mixing losses occur within a subsonic jet pump, it has been possible to apply boundary-layer technology to improve internal aerodynamics. A peak efficiency of 41 per cent was attained as contrasted against conventional jet pumps having less than 10 per cent.

The high-performance jet pump studied incorporates features to exploit mixing improvement which occurs in favorable pressure gradient and to overcome sensitivity to irregularities in the total-head profile at inlet, an adverse condition encountered during diffusion. This pump consists of the primary blower and nozzle, the jet pump itself, the blower for boundary-layer control, and an adjustable mounting base to permit positioning of the primary nozzle relative to the jet-pump inlet.

A theoretical expression is derived for ideal efficiency of mixing in a favorable pressure gradient that shows agreement with experimental results. The results are compared with another recent work in this field.

Maintenance of Simple-Cycle Natural-Gas-Burning Gas Turbines During Ten Years' Operation in Utility Service..60—Av-20...By Joel W. Blake, Mem. ASME, Oklahoma Gas and Electric Co., Oklahoma City, Okla. 1960 ASME Aviation Conference paper multilithographed; available to April 1, 1961).

The first gas-turbine unit to be used as a prime mover for utility service in the United States was placed in operation by the Oklahoma Gas and Electric Co. on July 29, 1949.

This unit also represented the first combined cycle application using a combination of steam and gas turbines. It was one of two units, the second being installed in 1952.

As these turbines are of a design having a steep load-economy curve, the units have been operated at full load. This operation up to the present represents base, peaking, and stand-by service. Details of the installation are given, and maintenance experience over a ten-year period is outlined.

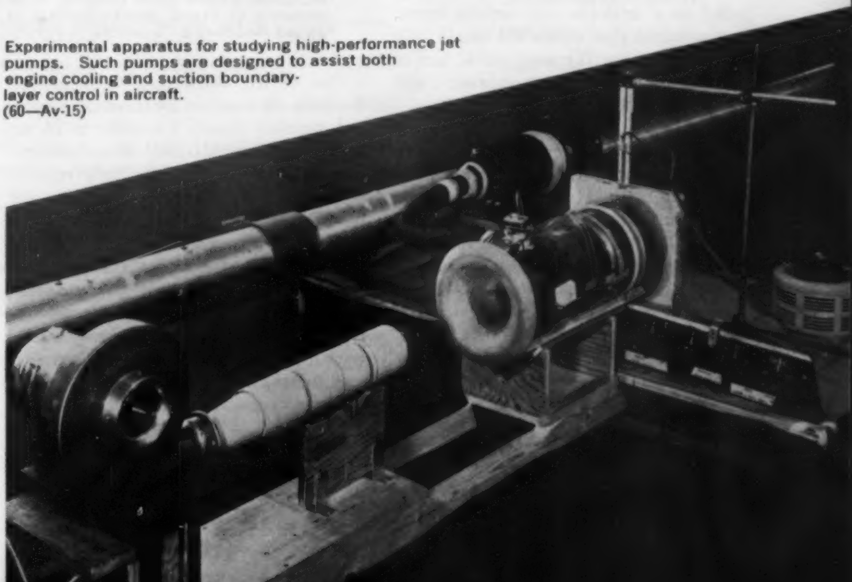
High-Efficiency Flow Diffusion by Means of Suction Boundary-Layer Control..60—Av-13...By I. Man Moon, The Johns Hopkins University, Baltimore, Md. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

Extensive investigations have shown that the efficiency of diffusers are critically restricted by flow separation, especially at high diffusion ratios. The diffuser is, furthermore, one of the most important parts of air-duct systems.

In order to obtain reasonable performance with classical approaches, a diffuser should be long and the expansion angle restricted to a maximum of 15 deg.

The author reports on an investigation of a possible application of distributed-suction boundary-layer control to improve the performance of wide-angle dif-

Experimental apparatus for studying high-performance jet pumps. Such pumps are designed to assist both engine cooling and suction boundary-layer control in aircraft. (60—Av-15)



fusers. Critical parameters that influence the performance of diffusers are also studied.

Two conical diffusers of 30-deg total expansion angle with an area ratio of 3.36 were constructed. The diffusers were designated as I and II.

The essential geometrical difference between diffusers I and II was the inlet transition to the cone. Diffuser I had an abrupt contour change at the inlet, and diffuser II had a transition section with an 18-in. radius of curvature.

Diffuser I was used to conduct a preliminary investigation.

Separation of the air flow in the diffuser was prevented by the boundary-layer control; however, it was found that the inlet-profile shape and the inlet-momentum thickness of the boundary layer were two important parameters.

Although the correlation of the transformation efficiency and the inlet-momentum thickness showed a considerable scatter, it appeared to indicate a limit at which the boundary-layer control was not effective. A slight indentation in the profile at the inlet caused a reversed-flow region downstream of the indentation. High turbulence in the flow, due to its energy dissipation, decreased the efficiency. Prevention of the flow separation in the diffuser not only resulted in high efficiency but also increased the total flow rate.

Glass-Reinforced Plastic as an Aviation Gas-Turbine Compressor-Housing Material..60—Av-17... By David R. Fraser, Gas Turbine Division, Westinghouse Electric Corporation, Kansas City, Mo. 1960 ASME Aviation Conference paper (multilithographed; available to April 1, 1961).

Corrosion problems experienced on magnesium components of jet engines operated in marine atmospheres prompted a study of glass-reinforced plastics as substitute materials.

The use of reinforced plastic would eliminate these problems without imposing weight penalties. The compressor housing, the largest magnesium component, was selected for initial study.

The development program was divided into three major phases: Materials testing, process development, and housing evaluation.

Three test housings were produced using the material and process developed by the first two program phases. One housing was assembled on a Westinghouse J34 type engine for endurance testing and the other two held for backup. The first housing tested completed the 150-hr endurance run with no signs of deterioration.

It is felt that the results of this program have proved the feasibility of using compressor housings made from glass reinforced plastic for long time operation in jet engines having compression ratios in the 4-to-1 range.

Applied Mechanics

Rupture Instability of Plane Membranes and Solids..60—APM-1... By S. F. Borg, Stevens Institute of Technology, Hoboken, N. J. 1960 ASME Summer Conference of the Applied Mechanics Division paper (in type; to be published in **Trans. ASME—Journal of Applied Mechanics;** available to April 1, 1961).

A fundamentally new approach to the rupture-fracture problem is presented.

The problem considers a thin, uniform-thickness, infinite plane membrane subjected to a uniform edge tensile stress. It is assumed that either the small hole and membrane will remain static and in equilibrium, or the membrane will rupture catastrophically.

Because of the particular type of dynamic phenomena being investigated, the formulation is given in terms of the conservation equations of continuum mechanics instead of in the usual elasticity-plasticity relations. The introduction of a similarity co-ordinate permits a complete closed-form solution to a particular problem of practical interest subject to certain compatibility conditions which depend upon the specific properties of the material considered.

It is shown that there is a possible combination of stress and material properties for which the membrane will rupture, and that this represents a criterion for rupture instability of the type considered.

The Junction Problem of Solid-Slotted Cylindrical Shells..60—APM-2... By D. H. Cheng, City College of New York, consultant, The M. W. Kellogg Co., New York, N. Y.; and N. A. Weil, Mem. ASME, Armour Research Foundation, Chicago, Ill. 1960 ASME Summer Conference of the Applied Mechanics Division paper (in type; to be published in **Trans. ASME—Journal of Applied Mechanics;** available to April 1, 1961).

One of the safest and most general methods of support for vertical closed-end pressure vessels (towers) is to set them on a comparatively short continuous cylindrical shell, commonly referred to as the skirt. In usual practice, the junction between the tower and the skirt is made by a continuous fillet weld.

Ordinarily, stresses at this junction are very high and, under cyclic conditions, may rapidly induce fatigue failures, especially at service conditions associated with high pressures or temperatures.

A solution is presented for the problem of three cylindrical shells, one of which is slotted lengthwise. With slot length as one of the parameters, the solution includes the solid three-shell problem as a particular case. The results are applicable to the stress problem of a closed-end vessel supported either by a slotted or an ordinary skirt, or one that is mounted on top of another vessel. It is shown that slotting substantially reduces the critical stress at the junction.

Extensional Vibrations and Waves in a Circular Disk and a Semi-Infinite Plate.. 60—APM-3... By D. C. Gazis, Assoc. Mem. ASME, General Motors Corp., Warren, Mich.; and R. D. Mindlin, Mem. ASME, Dept. of Civil Engineering, Columbia Univ., New York, N. Y. 1960 ASME Summer Conference of the Applied Mechanics Division paper (in type; to be published in **Trans. ASME—Journal of Applied Mechanics;** available to April 1, 1961).

A set of approximate equations of extensional motion of elastic plates is solved for the case of axially symmetric vibrations of a circular disk and the results are compared with experiments performed by E. A. G. Shaw.

Special attention is given to a new mode of vibration, discovered by Shaw, in which the deformation is predominantly at the edge of the disk. It is shown how this mode arises from the complex conjugate roots of the frequency equation of an infinite plate.

The properties of the edge-mode are examined in detail in a study of the reflection of straight-crested extensional waves at the edge of a semi-infinite plate.

Transient and Residual Thermal Stresses in an Elastic-Plastic Cylinder..60—APM-4... By H. G. Landau, Heat and Mass Flow Analyzer Laboratory, Columbia Univ., New York, N. Y.; and E. E. Zwicky, Jr., Mem. ASME, General Electric Co., Schenectady, N. Y. 1960 ASME Summer Conference of the Applied Mechanics Division paper (in type; to be published in **Trans. ASME—Journal of Applied Mechanics;** available to April 1, 1961).

Inelastic stresses in cylinders due to transient temperature distribution are of interest because of their possible threat to the physical integrity of the part, and because they may leave residual stresses which can influence the later performance of the cylinder.

Equations are given for the stress rates in solid cylinders subject to transient temperature distributions, based on the assumption of an elastic, perfectly plastic material obeying a von Mises temperature-dependent yield condition.

A numerical procedure for integrating the equations is developed and applied to a temperature distribution approximating a phase transformation and to a quenched cylinder. The effect of various factors on the residual stresses is noted.

ASME TRANSACTIONS

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Includes Letters from Readers on Miscellaneous Subjects

COMMENTS ON PAPERS

Electrostatic Precipitators

Comment by M. J. Archbold[1]

WHEN considering the different types of dust-collector plates which the electrical companies have on their system, it is certainly timely that someone came up with a type of plate which shows improvement. There is little question but that the performance of our dust collectors is directly and definitely influenced by the type of dust-collector plate. The writers[2] are to be congratulated upon their efforts to get some factual data about a new type of plate before the engineering profession.

The dust-collector plates, which are now on the Commonwealth Edison Company system, are the perforated, the expanded metal, the V-pocket or chevron, and the plain sheet-type which is mentioned in this article. Each of these different types may have their place in collecting certain kinds of finely divided materials. For the pulverized coal, or cyclone-fired furnace dusts, it is questionable whether or not best results are obtained with any of these except the solid plate-type. With seven dust collectors using the V-pocket-type of plate on our system, we find that that plate is especially susceptible to retaining a large amount of fly ash in the pockets. In fact, large areas of the plate are often so full that it appears as though someone had troweled this material into the pockets. There is little question in our mind that, at the time of rapping, some of this material does fall out and, as it falls, the re-entrainment of dust increases materially. The space between both the expanded metal and the perforated plates is subject to filling so that in actual practice instead of having two perforated or expanded metal plates spaced $^{1}/_{2}$ in. or $^{5}/_{8}$ in. apart, the space in-between is filled solidly and we have a solid $^{5}/_{8}$ in. thick plate. In addition to this, the dust builds up on this area and becomes so thick that the total plate thickness may be upward of $1^{1}/_{2}$ in. Most of our dust collectors are of this type, and we do not consider that these are especially satisfactory. We have two dust collectors which utilize the solid type of plate, and these collectors are the best performers on the system. It is not known how much can be attributed to the solid plate since there were other things done in the design of these dust collectors which tended to improve their performance. For example, the gas flow into the collectors was the subject of model testing for greater uniformity of flow distribution; also, we were able to increase the amount of power going to the collectors.

In addition to that, we have also installed rappers on the wires, and it is believed that we now have a better type of rapping, as well as more fields in series, all of which tend to improve the performance of the dust collector as compared to other jobs where there are no wire rappers. These collectors have been inspected a couple of times since they went into service about a year ago.

The inspections showed that the plates were commercially clean. However, either the plates or the wires are not as clean as they were originally because the total amount of voltage that can be impressed upon the d-c system has decreased 5000 to 6000 volts.

[1] General mechanical engineer, Commonwealth Edison Company, Chicago, Ill.

[2] Harry J. White and Walter A. Baxter, Jr., "Electrostatic Precipitators," MECHANICAL ENGINEERING, vol. 82, May, 1960, pp. 54–56.

Comment by D. F. Schick, Jr.[3]

The authors[2] and Research-Cottrell, Inc., are to be commended in their continuing investigation and research relative to improved performance of electrostatic precipitators as outlined in their paper.

It is most important that research of this type be encouraged and stimulated. Commercial grade coals for utility use vary from 5 per cent to 15 per cent incombustible ash which cannot be discharged and must be removed from the furnace, or removed from the gas stream with efficient collectors.

Recent advance in electrostatic precipitator design is most encouraging. Additional topics for investigation are suggested:

(1) Improved methods for removal of fly ash from precipitator and hoppers after collection, especially with operation at low exit gas temperatures.

(2) Further development of precipitators operating with high temperatures and located in high-velocity range in the gas circuit.

(3) Encouragement of model work directed toward improved gas and fly-ash distribution leading to and within the precipitator.

[3] Design engineer, Mechanical Division, Philadelphia Electric Company, Philadelphia, Pa. Mem. ASME.

Authors' Closure

The authors wish to thank Messrs. Archbold and Schick for their informative discussion. Our experience in both the laboratory and in industrial application supports Mr. Archbold's remarks on the tendency of partially open collecting plate designs to pack solid with the collected material. As discussed in the paper, experiment indicates that the plate design recommended will allow for a greater power input to the precipitator.

Mr. Schick's suggested topics for investigation are timely. Our company has done considerable model work on gas and dispersoid distribution; in particular, we call your attention to ASME Paper No. 59—A-280, "Application of Model Studies to Industrial Gas-Flow Systems," by C. L. Burton and R. E. Willison.

Walter A. Baxter, Jr.[4]

[4] Project engineer, Research Section, Research-Cottrell, Inc., Bound Brook, N. J.

The Engineer in International Affairs

Comment by Paul W. Nordt, Jr.[5]

ASME President Walker L. Cisler, in his Roy V. Wright Lecture,[6] has added an important new dimension to the late Dr. Wright's great mission to impress engineers with their duties as citizens. Responsible citizenship on a world basis is, indeed, as important as on more local levels.

Mr. Cisler said, "He [the engineer] must have empathy—an understanding of others that can take into account the dignity of other cultures and the nuances of other manners. He must be able to implant his skills and experience in a friendly way, feeling genuinely the utmost consideration for the intelligent people whom he will meet, and who are as sensitive as they are delightful. He will learn much from them in return and establish friendships based upon mutual accomplishment."

A cynic might well scoff that when we deal with a country like Russia on the basis of personal friendliness and mutual respect we are in danger of being "played for a sucker." We must remember, though, that a man of good will is always in danger of that; nevertheless, we must further recall that America itself was built on the Christian doctrine of love for one's fellow man, not upon suspicion and isolation.

[5] Vice-President, John C. Nordt Company, Inc., Cedar Grove, N. J. Mem. ASME; member, ASME Civic Affairs Committee.

[6] W. L. Cisler, "The Engineer in International Affairs," Mechanical Engineering, vol. 82, February, 1960, pp. 54–56.

BOOKS RECEIVED IN LIBRARY

Plastics Engineering Handbook

By the Society of the Plastics Industry, Inc. Third Edition. 1960, Reinhold Publishing Corporation, New York, N. Y. 565 p., 7 × 10¹/₄ in., bound. $15. This new edition on plastics materials, methods, and fabrication includes advances made in the field since 1954 in cellular plastics, decorationg, welding, adhesives, and the nomenclature. Every step in the manufacturing operation is described; and these include compression, transfer, injection and cold molding, preforming and drying, extrusion, casting, tooling, embedding and potting, machining, and finishing. Reinforced plastics, vinyl dispersions, design of articles and molds, fabrication of articles from thermoplastic sheets, welding and assembly, and performance testing are also dealt with.

Practical Prestressed Concrete

By H. Kent Preston. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 340 p., 6¹/₄ × 9¹/₄ in., bound. $11.50. A compilation of basic principles and procedures in the design of structures of prestressed concrete, with illustrative examples using simple arithmetic and standard stress and moment formulas, in some of which inadequate sections deliberately are used to demonstrate corrective measures. The economy of the section is examined at different stages of design, before it progresses too far. Construction methods and equipment are discussed with emphasis on American practice.

The Sea Off Southern California; A Modern Habitat of Petroleum

By K. O. Emery. 1960, John Wiley & Sons, Inc., New York, N. Y. 336 p., 7¹/₄ × 10¹/₂ in., bound. $12.50. A synthesis of information from scientific writings of the past 120 years, on various aspects of the sea floor, the water, and the marine life off Southern California. A 20-page double-column appendix lists the references studied to produce this integration of basic knowledge. Topics covered include the physiography, lithology, and structure of the sea floor; the currents, waves, and tides; the life of the intertidal, pelagic, shelf, and basin environments; the general composition, sources, deposition, and other features of sediments; and economic aspects of these phases of the marine environment. A map of land and submarine topography is included as an insert.

Servomechanism Fundamentals

By Henri Lauer and others. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 491 p., 6¹/₄ × 9¹/₄ in., bound. $10. The opening chapters present a detailed account of the basic properties of servo control devices, a presentation of the most usual "follow-up link" devices, and a review of the fundamental concepts of mechanics and electricity used in servotechniques. The operating features of servomechanisms are then discussed and their theory is developed through transient-response analysis methods, using classical methods in the solution of the differential equations. Chapters on transfer function analysis of servomechanisms, and nonlinear servo systems are included. The final chapter is composed of design problems and extension of servo control concepts to other applications, such as regulators.

Sir Casimir Stanislaus Czowski

By Ludwik Kos-Rabcewicz-Zubkowski and William Edward Greening. 1959, Burns and MacEachern, Toronto, Canada. 213 p., 5³/₄ × 8¹/₂ in., bound. $4.75. The biography of an eminent Polish-born (1815) engineer whose professional life was closely interwoven with engineering developments in Canada. His supervisory job in the construction of the Erie Canal and Railroad, achieved after six years in the United States, led him to Ontario in 1841. Until his death in 1898 he was active in the construction of roads, railroads, and bridges; in inland waterway surveys; and in patriotic and community activities; accumulating a quantity of honors.

Solid State Physics, Vol. 8

Edited by Frederick Seitz and David Turnbull. 1959, Academic Press, Inc., New York, N. Y. 519 p., 6¹/₄ × 9¹/₄ in., bound. $13.50. This eighth volume in a series presenting advances in solid-state physics research and applications begins a policy of focusing more attention on the properties of organic solids by presenting the first half of an article on electronic spectra, dealing with the electronic states of molecular crystals. Other papers discuss photoconductivity in germanium, the interaction of thermal neutrons with solids, electronic processes in zinc oxide, and the structure and properties of grain boundaries.

Solid State Physics, Vol. 9

Edited by Frederick Seitz and David Turnbull. 1959, Academic Press, Inc., New York, N. Y. 548 p., 6¹/₄ × 9¹/₄ in., bound. $14.50. This ninth volume of a series presenting advances in research and applications continues the emphasis on organic solids with the second half of an article on electronic spectra begun in volume eight, dealing with the spectra of ions in crystals, and with an article on the electronic spectra of aromatic molecular crystals. Other papers discuss polar semiconductors, static electrification of solids, heterogeneities in solid solutions, the oscillatory behavior of magnetic susceptibility and electronic conductivity, and the interdependence of solid-state physics and angular distribution of nuclear radiations.

The Surface Treatment and Finishing of Aluminum and Its Alloys

By S. Wernick and R. Pinner. Second Edition. 1959, Robert Draper Ltd., Teddington, England. 607 p., 5¹/₂ × 8³/₄ in., bound. $13. A comprehensive and up-to-date review of processes for the surface treatment and finishing of aluminum and its alloys, with an introductory chapter on history, development, and corrosion. New material has been added on most subjects, including hard anodising, chromate treatment, electroplating, vitreous enameling, contour etching, abrasive blasting, and mechanical and chemical polishing. The composition and properties of major British and U. S. aluminum alloys are given in appendix tables.

Symposium on Education in Materials

Published 1960, as Special Technical Publication No. 263, by the American Society for Testing Materials, Philadelphia, Pa. 51 p., 6 × 9 in., paper. $2. Seven prominent engineers and educators present from their varying points of view the impact of engineering materials requirements as related to engineering educators.

The Theory of Optimum Noise Immunity

By V. A. Kotel'nikov. 1959, McGraw-Hill Book Company, Inc., New York 36, N. Y. 140 p., 7¹/₄ × 10¹/₄ in., bound. $7.50. This verbatim translation of a 1956 Moscow publication is an extensive analysis of the effects of additive Gaussian noise on communication systems and examination of noise-minimizing methods in reception techniques. The primary intention is to establish the behavior of communication systems at a practical level for the engineer, and only elementary notions of probability theory and a minimum amount of advanced mathematics is employed. Extensive use is made of geometric models of the signaling and detection

process as operations on vectors in multidimensional space.

Thermochemistry for Steelmaking, Vol. 1

By John F. Elliott and Molly Gleiser. 1960, Addison-Wesley Publishing Company, Inc., Reading, Mass. 296 p., $8^1/_2 \times 11^1/_4$ in., bound. $10.50. This volume is the first of several to be issued containing a collection of tables and charts on the high-temperature chemistry of iron and steelmaking, and presenting information mutually consistent with regard to base states, reference states, and the like. This volume contains basic physical and thermochemical properties of selected elements; standard heats and free energies of formation of inorganic carbides, nitrides, oxides, phosphides, and silicides; and the vapor pressures of selected elements and compounds on the Kelvin temperature scale. Tabular data are extrapolated to 3000 K and thermochemical properties are extrapolated assuming C_p is constant above 2000 K.

Torsion Devices

By P. J. Geary. 1960, British Scientific Instrument Research Association, Chislehurst, Kent, England. 142 p., $6 \times 9^1/_2$ in., paper. 23s. 6d. This book reviews the design, construction, and application in instruments of torsion devices used as frictionless suspensions for the moving parts of sensitive instruments, as hinges for levers and the like, and for the magnification of small displacements and the indication of small forces. Included are a 40-page annotated bibliography and a numerical index to British, French, German, Swiss, Swedish, and American patents. Part no. 3 in the BSIRA Survey of Instrument Parts.

Vector Analysis With Applications to Geometry and Physics

By Manuel Schwartz and others. 1960, Harper & Brothers, New York, N. Y. 556 p., $6^1/_4 \times 9^1/_2$ in., bound. $7.50. Students and practicing engineers should find this book useful in studying fundamental concepts and techniques of vector analysis. The authors believe that vector analysis should be considered as both a mathematical discipline and a language of physics; therefore, applications, or relations between vector analysis, geometry, and physics, are carried along with mathematical theory. After covering the calculus and simpler applications in statics, kinetics, dynamics, and potential theory, specialized topics such as differential geometry, harmonic functions, electricity, and magnetism are dealt with. The final chapter on linear vector functions introduces dyadics and their application to hydrostatics, hydrodynamics, and elasticity. Many examples and problems are included.

ASTM Standards on Plastics

Eleventh Edition. Published 1959 by the American Society for Testing Materials, Philadelphia, Pa. 1219 p., $6^1/_4 \times 9^1/_4$ in., bound. $9. This volume is concerned with the mechanical, optical, thermal, and permanent properties of plastics; molds, molding processes and compounds, molded shapes and base materials; analytical methods, definitions, nomenclature, and conditioning of plastics; rubber and adhesives; laboratory ovens; paper and cellulose acetate. Where they have been established, specifications, methods of test, or recommended practice are given in each case.

ASTM Standards on Light Metals and Alloys

Fifth Edition. Published 1959 by the American Society for Testing Materials, Philadelphia, Pa. 355 p., $6 \times 9^1/_2$ in., bound. $4.50. Includes specifications and general methods of test for cast and wrought aluminum and magnesium and their alloys, methods of test for conductivity and resistivity, some specifications for filler metal, and recommended practice for electroplating on aluminum alloys.

Artificial Earth Satellites

Edited by L. V. Kurnosova. 1960, Plenum Press, Inc., New York, N. Y. Two volumes in one, $6 \times 9^1/_2$ in., bound. $9.50. Translation of information on the results of the Soviet Union's first three earth satellites. Separate papers include the data obtained in orbit, discussing methods of observation, cosmic-ray measurements, upper atmosphere and electron density, orbit parameters, and other areas of upper-atmosphere research. Volume 1 includes space biology and data on Laika, the first astronaut. Volume 2 includes discussion of similar investigations carried out with rockets.

Certain Dynamic Problems of the Theory of Shells

By O. D. Oniashvili. Published by Morris D. Friedman, Inc., West Newton, Mass. 178 p., $8^1/_2 \times 11$ in., paper. No price given. This translation from the Russian discusses the vibrations, the dynamic stability, and the resistance-to-earthquakes of thin-walled shells, used primarily as roofs and ceilings in industrial and domestic buildings. Included is an explanation of the hypotheses and most important relations of the Vlasov engineering moment theory of shallow shells.

Colloque sur la Diffusion a l'État Solide, 1958
Symposium on Solid State Diffusion

Published 1959 by the Centre d'Études Nucléaries de Saclay, Saclay, France. 175 p., $8^1/_2 \times 11$ in., bound. $6.25. Twenty-one specialized papers comprise this symposium. Specific types of diffusion investigated are chromium in titanium, metals in thin metallic films, helium in metals, oxygen in zirconium, uranium-titanium, hydrogen in iron, etc. Other topics include methods of measuring diffusion, energy of solution of rare gases in metals, and investigations of brittleness, ionization, preferential location, etc., as diffusion phenomena. Only three papers are in English but all have English summaries.

Computer Handbook, 1960

Published 1960 by the Instruments Publishing Company, Inc., Pittsburgh, Pa. 76 p., $8^1/_2 \times 11^1/_4$ in., paper. No price given. The analog section of this collection of papers includes discussion of the EDA, simulation, computer reliability, and new techniques and mathematical elements for computation. The digital section covers the DDA, control, natural-gas-dispatching and solid-state process computers, the digiverter, digital printing, desk calculators, and other small and medium-sized computers.

Distortion in Tool Steels

By Bernard S. Lement. 1959, American Society for Metals, Metals Park, Novelty, Ohio. 173 p., $6 \times 9^1/_4$ in., bound. $10. This book treats the theoretical and practical aspects of dimensional changes in tool steels, with a minimum of mathematical analysis. "Reversible" changes due to stressing in the elastic range or to temperature changes; and "irreversible" changes due to phase transformations, introduction of residual stress, and relief of residual stress, both are considered. The discussion covers the causes, measurement, and control of distortion, and commercially accepted methods of hardening, cold treating, tempering, and aging.

Engineering Economy

By E. Paul de Garmo. Third Edition. 1960, The Macmillan Company, New York, N. Y. 580 p., $6^1/_4 \times 9^1/_2$ in., bound. $8.75. All commonly used economy study methods here are analyzed in terms of their background, principles, and procedures, together with discussion of the frequent importance of nonmonetary factors in economic decisions. This edition is almost completely rewritten.

Feedback Control System Analysis and Synthesis

By John J. D'Azzo and Constantine H. Houpis. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 580 p., $6^1/_4 \times 9^1/_4$ in., bound. $13.50. First presented are the principles of obtaining differential equations for electrical, mechanical, hydraulic, and heat-flow systems, the classical solution of differential equations, demonstrating the Laplace transform and the block diagram methods, and a detailed discussion of basic servo characteristics. Then such methods of analysis as root locus, frequency techniques, and compensation techniques, and optimum loss, a-c systems, nonlinearities, and computers are discussed. The final section presents some experimental methods and synthesizes the methods presented throughout the book.

Fluid Power Control

Edited by John F. Blackburn and others. 1960, John Wiley & Sons, Inc., New York, N. Y. 710 p., $6 \times 9^1/_4$ in., bound. $17.50. Following a review of fluid properties and fluid mechanics, the theory and practice of hydraulic control components, emphasizing control valves, is covered in detail. Recent progress with gaseous working fluids, particularly high-pressure pneumatics, is discussed in the final section, including systems analysis and design. Over-all emphasis is on conversion, transmission, and control of fluid power under conditions for which gravitational effects are negligible. Topics discussed include flow of fluids through closed conduits, orifices and valves, variable-volume chambers. pumps, motors, and accumulators.

German-English Mathematics Dictionary

Compiled and edited by Charles Hyman. 1960, Interlanguage Dictionaries Publishing Corporation, New York, N. Y. 131 p., $8^1/_2 \times 11$ in., bound. $8. Intended as a supplement to a general German-English dictionary, this list excludes nontechnical every-day translations, but includes the varied meanings of a term in different applications. Model phrases and sentences are used often to show precise meaning and use, but most definitions are terse.

International Association for Bridge and Structural Engineering, Publications 1959 Vol. 19

Published 1959, in Zurich. 296 p., $6^3/_4 \times 9^1/_2$ in., paper. SFr. 40.00. Various aspects of steel and reinforced-concrete construction falling within the Association's province are the subjects of these 15 papers: the theory of trusses, of cylindrical shells, and of orthotropic plates; the plastic theory of structures; buckling loads, deformation of ring girders, boundary conditions; analysis of a skew girder-bridge, design of frameworks for specific deflections; etc. Most of the papers are in English; the others have English summaries.

International Symposium on High Temperature Technology—Proceedings

Arranged by Stanford Research Institute.

1960, McGraw-Hill Book Company, Inc., New York, N. Y. 348 p., $8^3/_4 \times 11^1/_4$ in., bound. $15. The papers in this volume form an account of the progress of fundamental research in specialized areas of high-temperature technology in the U. S. and abroad. The section on techniques and measurements contains papers on the image furnace, on measurement of temperatures and properties, and on reactions. Metals, oxides, refractories, and thermal transfer are dealt with in the materials section. Processes discussed are high-pressure methods, condensed state reactions, fused salt chemistry, pyrometallurgy, and high-temperature chemical synthesis. Other topics covered are mechanical properties of metals, thermoelectric power, mass spectrometry in high-temperature chemistry, and research abroad.

La Machine-Outil, Vol. VII and VIII

Edited by A. R. Métral. 1959, Dunod, Paris, France. 2 vol., $7^3/_4 \times 11$ in., bound. Fr. 7400 and Fr. 3900. Vol. 7 of this encyclopedic series on machine-shop practice deals with forging and stamping equipment. In addition to description of the machinery and operating methods, there are also sections on the metallurgical aspects of forging practice and on forgeability, deformation, and the determination of suitable pressures. Vol. 8 consists of four sections as follows: Wood working; plastics molding; electronic automatic control of machine tools; hydraulic and electrohydraulic drives and controls.

Magnesium and Its Alloys

By C. Sheldon Roberts. 1960, John Wiley & Sons, Inc., New York, N. Y. 230 p., $6 \times 9^1/_2$ in., bound. $9. The extraction and refining of magnesium, alloy theory, and phenomena, and the physical and chemical properties of the metal and its alloy systems are covered in detail. The technology of both casting and wrought alloys is included.

Manual on Industrial Water and Industrial Waste Water

Second Edition. Published 1960 as ASTM Special Technical Publication No. 148-D by the American Society for Testing Materials, Philadelphia, Pa. 653 p., $6^1/_4 \times 9^1/_4$ in., bound. $11. Revision of the introductory section presents a general discussion of the characteristics and potential effects of waste water discharged from the plant, as well as of the characteristics of fresh water for industrial use. The remainder of this volume includes all current ASTM methods for the examination of water.

Manual of Machinability and Tool Evaluation

By Antoni Niedzwiedzki. 1960, Huebner Publications, Inc., Cleveland, Ohio. 97 p., 6×9 in., paper. No price given. The author has combined his evaluation and analysis of the basic concepts on metal-cutting derived from world-wide technological centers with the results of his own experiences, to show that within the practical limits of normal feeds and speeds it is possible to predict the amount of tool wear obtained in a given cutting time for a given set of machining conditions. In addition, the feasibility of advance calculations of the power consumption for a given set of machining conditions, workpiece, and cutting tool is demonstrated.

Mechanical Properties of Intermetallic Compounds

Edited by J. H. Westbrook. 1960, John Wiley & Sons, Inc., New York, N. Y. 435 p., $6 \times 9^1/_4$ in., bound. $9.50. The proceedings of the Electrochemical Society's 1959 Symposium, this book includes papers on the phenomenology of the mechanical behavior of intermetallics, theoretical and experimental investigations of particular properties, experimental techniques for the preparation and study of intermetallics, and an extensive review of the literature in the field, from about 1908 to date. Included is an index to the compounds discussed.

LIBRARY SERVICES

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Motor Selection and Application

By Charles C. Libby. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 508 p., $6^1/_4 \times 9^1/_4$ in., bound. $13.50. Based on ASA, AIEE, and NEMA standards, and written to guide those responsible for the selection, application, and maintenance of electric motors for industrial use, this book describes motor selection in terms of load characteristics, service requirements, space limitations, duty-cycle requirements, and safety. Motor temperature rise is discussed in relation to motor insulation, motor temperature, and various load cycles. The book also covers load torque characteristics for induction, synchronous, and direct-current motors, and demonstrates the relation of load variables to motor characteristics. Motor enclosures as protection for all types of industrial motors are analyzed. Preventive maintenance and compensating mechanical arrangements for changing loads are also covered.

Nuclear Fusion

Edited by William P. Allis. 1960, D. Van Nostrand Company, Inc., Princeton, N. J. 488 p., $6^1/_4 \times 9^1/_4$ in., bound. $12.50. An edited and subject-indexed selection from the papers on fusion presented at the 1958 Geneva Conference on Peaceful Uses of Atomic Energy. The book has three major sections: Survey papers, general plasma properties, and thermonuclear machines.

Nuclear Physics and Atomic Energy; Terms . . . In English, French, German, Russian

By Georges J. Béné and others. 1960, D. Van Nostrand Company, Inc., Princeton, N. J. 213 p., $5 \times 7^1/_2$ in., paper. $6. This four-language glossary presents a four-column list of equivalents alphabetized by the English term, each entry numbered, with supplementary lists in the other three languages keyed to this basic list. The Russian entries are not transliterated. This is the first of a series of glossaries, each bearing on one of the principal subjects discussed at international conferences.

Progress in Non-Destructive Testing, Vol. 1

Edited by E. G. Stanford and J. H. Fearon. 1959, The Macmillan Company, New York, N. Y. 267 p., $6^1/_4 \times 10$ in., bound. $12. The first of an annual series containing international critical reviews of any type of non-destructive measurement carried out on solids, liquids, and gases, with the object of examining some aspect of their physical, chemical, or biological condition. Included in this volume are discussions of industrial and neutron radiography and ultrasonic inspection, as well as application of electromagnetic, thermal conductivity, and nuclear magnetic resonance techniques.

Rocket Propellant Handbook

By Boris Kit and Douglas S. Evered. 1960, The Macmillan Company, New York, N. Y. 354 p., $6^1/_2 \times 9^1/_2$ in., bound. $12.50. The general characteristics, physical and chemical properties, methods of storing and handling, and performance characteristics of nearly one hundred chemicals, including fuels, oxidizers, and monopropellants, all potential rocket propellants, are given in this book. Each entry includes tables of such data as heat value, density at various temperatures, specific impulse, and performance with alternate oxidizers or fuels.

The Scientific Papers of Sir Geoffrey Ingram Taylor, Vol. 2: Meteorology, Oceanography and Turbulent Flow

Edited by G. K. Batchelor. 1960, Cambridge University Press, Cambridge, Mass. 515 p., 7×10 in., bound. $14.50. The phenomenon of turbulence and its effect provide the main theme of this, the first of three volumes in this series to be devoted mostly to Taylor's work on the mechanics of fluids, but it also contains a wide range of geophysical investigations. Included are papers on diffusion in the atmosphere, formation of fog, tidal friction, tidal oscillations in gulfs, oscillations of the atmosphere, stability of stratified fluids, and convection from sources.

Second Protective Construction Symposium; Proceedings: Deep Underground Construction

Compiled by J. J. O'Sullivan. 1959, The RAND Corporation, Santa Monica, Calif. 2 vol., $10^1/_2 \times 11^1/_2$ in., loose-leaf. No price given. This large, two-volume loose-leaf collection of papers stresses primarily the design and construction of deep underground industrial facilities to resist the effects of nuclear weapons. Topics discussed include the need for shelters, weapons effects to be provided against, the interaction of utilities and structural solutions, tunnel design and failure mechanism, and experiences from such fields as submarine design, oil-well drilling, and underground powerhouse design.

Servomechanism Practice

By W. R. Ahrendt and C. J. Savant. Second Edition. 1960, McGraw-Hill Book Company, Inc., New York, N. Y. 566 p., $6^1/_4 \times 9^1/_4$ in., bound. $12.50. The numerous methods of achieving the essential functions of servomechanism components are described in this text, and the problems associated with the operation of servos and their components, and design, manufacturing, and testing techniques are discussed. Emphasis is placed on the practical aspects of servo components, circuits, and systems, but theoretical data and both root locus and frequency response stability methods are included.

Current Engineering Events, News, and Comment

E. S. NEWMAN
News Editor

THE ROUNDUP

EJC Mission to Russia Studies Utilization of Engineers and Technicians

QUESTION: Is Soviet engineering education creating engineering manpower which will win the cold war for Russia?

Insight into the Soviet educational system has been brought back by a six-man delegation of engineers and educators sent to the Soviet Union by the Engineers Joint Council. The mission, the first of its kind, was supported by the National Science Foundation and came under an exchange agreement between the United States and the USSR. The Soviets will, of course, have a similar mission visit us.

The delegation's preliminary report can be summarized as follows: The Soviet technical education is of high quality, its theoretical and mathematical content above that generally given in the bachelor-degree programs in the U. S.; the training is well calculated to serve the Soviet needs at this time. (Example: A Soviet student's thesis is always on a subject that solves a real and immediate problem of the plant to which the student is to be assigned.)

The Engineers Joint Council, 29 West 39 Street, New York 18, N. Y., is a federation of societies—among them ASME—whose membership totals a quarter of a million engineers. The delegation selected by EJC consisted of the following members: W. E. Lobo, Mem. ASME, consulting chemical engineer, New York, N. Y. (Chairman); H. R. Beatty, Mem. ASME, president of Wentworth Institute, Boston, Mass.; C. S. Dargusch, adviser, Engineering Manpower Commission, Columbus, Ohio; Oleg Hoeffding, economist, The RAND Corporation, Santa Monica, Calif.; S. B. Ingram, director of technical employment, Bell Telephone Laboratories, Inc., Murray Hill, N. J.; and R. M. Mahoney, manager of the industrial relations department, Union Carbide Corporation, New York, N. Y.

Industry Comes First

They report that the Soviet goal,

EJC Mission to Russia studied utilization of engineers and engineering technicians and their interrelationship in the Soviet Union. Shown on their return to the U. S. A. are, **left to right**, Chairman W. E. Lobo, Mem. ASME, New York City; H. R. Beatty, Mem. ASME, Boston, Mass.; C. S. Dargusch, Columbus, Ohio; Oleg Hoeffding, Santa Monica, Calif.; S. B. Ingram, Murray Hill, N. J.; and R. M. Mahoney, New York City.

today, is to admit not more than 20 per cent of their high-school students directly to higher education. The remaining 80 per cent have to spend two years in practical work in industry before being permitted to continue their education. Even the 20 per cent directly admitted are required, as part of their education, to spend one year and four months in practical work in industry. Thus it becomes possible for the Soviet institutions to strengthen the theoretical content of their engineering program. Foreign languages and political economy are included in the curriculums, but not the more humanistic social courses we give.

The delegation was told that the USSR is producing 250,000 industrial "technicum" graduates (technicians) each year. (We in the U. S. graduate 14,000 to 16,000—and not more than 1000 of ours are of the quality produced by the technicums visited by the delegation.) Also, a considerable number of technicum graduates go on in engineering education to qualify as engineers. Soviet enterprises are using technicians effectively to support the work of engineers in research, design, and production.

Some 108,000 engineers are graduated each year in the USSR, but many are first put to work as technicians. The Soviets regard production as their first problem.

About one third of the students in engineering institutes and technicums are women, and they are employed in a wide range of technical positions. One member of the delegation offers as his opinion that the extensive use of women in industry arises not so much from the desire of women to take part in such work as from the manpower shortage caused by the fearful losses suffered in World War II. When the balance of population is back to normal, there will be a smaller percentage of women going into industry.

Since technical education is one of the principal avenues to higher status and economic privilege, there is high motivation in both institutes and technicums. This helps explain the low failure rate—less than five per cent, as against an attrition that may run as high as 50 per cent in our country. Another motivating factor is the stipends which are given to 75 to 80 per cent of all students, on a basis of their academic performance.

Questions and Answers

Here are some of the questions and answers that came out at a conference at which the newly returned delegation met the press:

Q Are the Soviets concentrating on turning out specialists or on engineers with a broad training?

A Engineering students are given broad basic instruction, on top of which they receive highly specialized training within their institutions. In the United States a student generally receives his specialized training in industry.

Q How many years does the Soviet curriculum require?

A Five and a half. This generally involves a four-year academic course plus one and one half years of practical training.

Q Are Soviet students more serious than Americans?

A Yes. There seems among undergraduates almost a coercive motivation to succeed. The institutions apparently do not waste time with borderline students. All schools visited had admitted only one out of every four applicants.

Q How does the American "C" average compare to the Soviet average student?

A The fact that 75 per cent or better receive stipends for academic accomplishment indicates a higher average.

Q Does Russia have professional registration of engineers?

A No. There are 25 so-called technical societies.

Under the present Soviet System all technical education is closely integrated with industry. The faculties of the technical institutions, aided by their students, are continually called upon to solve problems of industrial plants—or "enterprises," as they are called there. About one third of faculty income comes from applied industrial problems. Engineering education positions which come, in general, only after many years in industry plus postgraduate study, carry more status and financial compensation than industrial positions.

This is the substance of the preliminary statement given by the delegation immediately on its arrival back in this country. A complete report will be issued by EJC at a later date.

PEOPLE

Honors and Awards. Henry T. Heald, Mem. ASME, president of The Ford Foundation, New York, N. Y., was elected Honorary Member of ASME.

C. S. Draper, Fellow ASME, of the Massachusetts Institute of Technology, has been named to receive the Howard N. Potts Medal for his work on inertial navigation by The Franklin Institute. Other recipients of awards by the Institute include A. L. Nadai, Fellow ASME, of Pittsburgh, Pa., who has been named to receive the Elliott Cresson Medal for his pioneering work in the field of elasticity of materials and plastic flow; and William Francis Gray Swann, ASME Lecturer, of Swarthmore, Pa., who has been named to receive the Elliott Cresson Medal for his investigations in the physical sciences, particularly in the field of cosmic radiation.

Lawrence W. Wallace, Fellow ASME, of Ordnance Weapons Command, Rock Island, Ill., has received a commendation for meritorious civilian service from the Department of the Army. The citation, one of the highest awards given by the Army to a civilian, was given for outstanding performance of duty as a training officer of the Ordnance Management Engineering Training Agency.

Harold R. Buhl, Assoc. Mem. ASME, associate professor of mechanical engineering, Iowa State University, Ames, Iowa, has received the second annual award of the Iowa State University Press for the most significant new book manuscript by a faculty member. His book, "Creative Engineering Design," will be published in September.

Fred A. Brooks, Mem. ASME, scientist, engineer, teacher, and recognized authority on microclimatology, received a Cyrus Hall McCormick Gold Medal for 1960. The award honoring his outstanding achievement in the field of agriculture was presented by the American Society of Agricultural Engineers.

Peter Ben Gordon, Mem. ASME, vice-president of Wolff and Munier, Inc., and past-president and Fellow of the American Society of Heating, Refrigerating and Air Conditioning Engineers, received ASHRAE's highest honor, the F. Paul Anderson Medal for 1960. The award was given for his contributions as engineer, educator, and businessman in society and industry activities.

Grover Loening, pioneer, engineer, and public servant, has been designated the Daniel Guggenheim Medal recipient for 1960, for his lifetime devotion to the advancement of aeronautics in America. Official presentation will be made by IAS at its Honors Night Dinner, Jan. 24, 1961.

Preston R. Bassett, left, and Robert B. Lea, Mem. ASME, inspect Elmer A. Sperry Centennial Exhibit installed at the Smithsonian Institute, Washington, D. C.

WALTER H. ZINN, vice-president in charge of Nuclear Activities of Combustion Engineering, Inc., has been named a Fellow of the American Nuclear Society. Dr. Zinn, who served as first president of the society, won the award for distinguished service and leadership in the development of nuclear energy, combining basic science and engineering, and for his personal contributions, which includes design of the experimental boiling water reactor.

PAUL SCHWARZKOPF, scientist and industrialist, one of powder metallurgy's earliest pioneers, was honored at the International Powder Metallurgy Conference, where he received a plaque from the Metallurgical Society of AIME. Dr. Schwarzkopf is president of the Schwarzkopf Development Corp., New York, N. Y., and of the Metallwerk Plansee, Reutte, Tyrol, Austria, Europe's largest powder metallurgical combine.

STEPHEN D. BECHTEL, president of Bechtel Corporation, San Francisco, Calif., has been selected as the 1961 recipient of the John Fritz Medal, awarded annually for scientific or industrial achievement. Mr. Bechtel, engineer, builder, and industrialist, is a pioneer in the creation and development of the modern construction industry.

The Elmer A. Sperry Centennial Exhibit, honoring the inventor, scientist, businessman, and founder of the Sperry Gyroscope Company, who died in 1930, was opened May 27 at the Smithsonian Institute. The exhibit, which marks the 100th anniversary of his birth, depicts incidents in the life of Mr. Sperry and displays his inventions. It will be open daily through September 24. Dr. Sperry is best known for his work with gyroscopes. His inventions also include mining machinery, electric automobiles, and storage batteries.

Appointments. WILLIAM T. ALEXANDER, Mem. ASME, dean of engineering at Northeastern University, and director of the Naval Reserve Officers School in Boston, has been appointed to the rank of Rear Admiral in the Naval Reserve, which he entered in 1927. He is a professor of industrial engineering.

ELLIOTT F. WRIGHT, Mem. ASME, chief engineer—Pump Developments of Worthington Corp., has been selected as an author for the forthcoming McGraw-Hill Encyclopedia of Science and Technology. Mr. Wright's 2000-word article on pumping machinery covers centrifugal pumps, displacement pumps, and electromagnetic pumps. Mr. Wright joins a team of more than 2000 specialist engineers and scientists who in the past two years have prepared 7200 separate articles covering the entire field of science and technology. The resulting work will be published this fall in 15 volumes.

COLONEL GORDEN B. PAGE, U. S. Army Corps of Engineers, was appointed Assistant Director for Army Reactors, Division of Reactor Development, and also will serve as Special Assistant for Nuclear Power, Office of the Chief of Engineers, U. S. Army.

New Officers. CLARENCE H. LINDER, Mem. ASME, vice-president and group leader, Electric Utility Group, General Electric Company, was elected president for 1960–1961 of the American Institute of Electrical Engineers.

FRED L. PLUMMER, Mem. ASME, national secretary of the American Welding Society, was elected International vice-president of the International Institute of Welding, with headquarters in Liege, Belgium.

The Fluid Power Society, a new technical organization serving the hydraulic and pneumatic power transmission fields, has elected as president FRANK L. MACKIN, chairman of Engineering Shops, General Motors Institute, Flint, Mich.; as vice-president, WALTER ERNST, Mem. ASME, vice-president and director of engineering, Commonwealth Engineering Company, Dayton, Ohio.

The National Society of Professional Engineers has elected as its president NOAH E. HULL, vice-president and general manager of the Hughes Gun Company, and assistant to the vice-president, manufacturing, of the Hughes Tool Company. BEN G. ELLIOTT, Mem. ASME, also was elected as one of six regional vice-presidents.

EDWARD J. WOLFF, of Edward J. Wolff and Associates, consulting engineers, Chicago, Ill., has been named to the Executive Committee of the Federation Internationale des Ingenieurs-Conseils (FIDIC). Mr. Wolff was elected by the International Federation at that organization's annual meeting June 1–4 in Stockholm, Sweden. Along with WILLIAM W. MOORE, Dames and Moore, consulting engineers, San Francisco, Calif., Mr. Wolff represented the Consulting Engineers Council of the United States at the Stockholm meeting.

MILES C. LEVERETT, manager—development laboratories for the General Electric Aircraft Nuclear Propulsion Department (ANPD) of Cincinnati, Ohio, was named president of the American Nuclear Society for 1960–1961.

Engineering Education Study. The status of nuclear engineering education in the U. S. will be investigated for one year, beginning in September, by the American Society for Engineering Education and the American Nuclear Society, under contract to AEC. Glenn Murphy, Mem. ASME, head of the newly formed Department of Nuclear Engineering, Iowa State University, and of the University's Department of Theoretical and Applied Mechanics, will head the investigatory group. It will be known as the Committee on Objective Criteria for

Nuclear Engineering Education. Included in the survey will be a study of the role of government laboratories and private industry in the nuclear field, as "consumers" of nuclear engineering talent.

Died. Aubry V. Hutchinson, 63, of Wyckoff, N. J., secretary-emeritus of the American Society of Heating, Refrigerating and Air Conditioning Engineers, died June 6. Mr. Hutchinson served 36 years with the Society and its precedent organization. He was associate editor of "The Metal Worker, Plumber and Steamfitter," 1916-1917, and worked for technical journals.

Three mechanical-engineering seniors at California State Polytechnic, San Luis Obispo, won the Mac Short Award given annually by the Society of Automotive Engineers for outstanding student projects. This is the seventh year in the last ten that Cal Poly engineering students have captured the trophy, given in memory of the late Mac Short, a Lockheed Aircraft official. The students, **left to right**, are Ronald W. Brown, Long Beach; Alan Shadbourne, San Marino; and Elliott Brown, Belmont. Their winning paper was on design, construction, and testing of a solar gas-turbine engine.

LITERATURE

News in Pamphlets

● "Education for the Atomic Age" presents the views of five American educators on international educational problems affecting America's role as a world power. Giving a well-rounded picture of the critical issues in education and science today, the booklet includes articles by James B. Conant, former president of Harvard University now engaged in a study of the American public high school; Nicholas DeWitt, associate of the Russian Research Center at Harvard; Grayson Kirk, president of Columbia University; Percy Bridgman, Nobel prize-winning physicist; and Hyman C. Rickover, developer of the atomic submarine. This aid is available free to teachers and librarians on request on institutional letterheads or at 25 cents a single copy and 20 cents each for 25 copies or more from the Library and Educational Division of Collier's Encyclopedia, 640 Fifth Ave., New York 19, N. Y.

● "You and Public Relations" is a 16-page booklet that shows how important good public relations are for the consulting engineer and how they can be attained. Some specific areas in which a favorable public image of a consulting engineer can be developed are listed, followed by what a sound public relations program can do for the individual consulting engineer, his firm, and his professional organizations. Available from: The Consulting Engineers Council, Springfield, Ill.

Foreign Publications

● "IP Standards for Petroleum and Its Products: Part IV—Methods for Sampling" has been published and is available at 10s. 0d. a copy from: The Institute of Petroleum, 16 New Cavendish Street, London, S. W. 1, England.

● "Symposium on Biomechanics," the proceedings of the 1959 biomechanics symposium held in London, is available from: The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London, S. W. 1, England.

● "Proceedings of the International Conference on Gearing" is a 553-page, bound volume containing the 41 papers presented at the gearing conference held in London, September 23-25, 1958. It is available at £5 5s. a copy, including postage, from: The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London, S. W. 1, England.

● "The Digest of Soviet Technology," a monthly abstract journal covering over 50 Soviet and eastern European technical publications, began publication in April. Fields included are: Mechanical engineering, production processes and methods, instruments, and automation. It provides translated tables of contents of 35 Russian, East German, Czech, and Polish periodicals. Annual subscription is $18 (sea mail) and $22 (air mail). Available from: Engineering Information Services, Kirkham, Preston, Lancashire, England.

EDUCATION

Science Honors

High-school students enrolled in Columbia University's Science Honors Program received a large number of New York State Regents Scholarships. Of the 159 eligible to take the examinations, 113, or 71 per cent, won scholarships. One hundred eleven won the regular Regents Scholarships, and of these 72 won the Regents Science and Engineering Scholarships. Two others won only the science and engineering scholarships. The Science Honors Program, attended by 204 gifted students, includes an elaborate group of lectures given by scientists from the Columbia faculties, visits to research laboratories and observatories, supervised individual and group projects, and guidance sessions. The program is supervised by the Joint Program for Technical Education in the university's School of Engineering. It was established in 1958 by a $25,000 grant from the Hebrew Technical Institute of New York which contributed a second $25,000 to continue the program.

Endowments

Stevens Institute of Technology, Hoboken, N. J., has received a gift of $1,250,000 from Mr. and Mrs. Eugene McDermott, Dallas, Texas, to be used for the new Stevens Center which will be the center of campus nonacademic activity.

Campus Improvements

● Excavation has begun on a $2,300,000 Metallurgy Building at Case Institute of Technology, Cleveland, Ohio. The six-story building, containing approximately 71,450 sq ft of floor space, will provide research laboratory and teaching areas for the investigation of the effect of ultra-high temperatures on materials and for the study of ultra-high strength materials. It will also provide facilities for a number of new fields on the Case campus such as ceramics. According to Dr. John A. Hrones, Mem. ASME, vice-president for Academic Affairs, the new building which will be completed

by September, 1961, is a major step in the Institute's plans to place increased emphasis on teaching and research in the materials field.

● STEVENS INSTITUTE OF TECHNOLOGY'S "Phase Two" building program got under way when construction began on a one-story addition to the Davidson Laboratory. Scheduled for completion by September, 1960, the new structure will house the Davidson Laboratory instrumentation shop which produces the delicate machinery used in model tests of ships and other vehicles.

● A NEW arc-discharge wind tunnel is exploring problems of space flight at Stanford University. Designed and built by three engineers of Stanford's Aeronautical Department, the wind tunnel generates hypersonic airstreams up to 12,000 mph and temperatures of 14,000 F or better, 1600 deg hotter than the surface of the sun. The machine creates an imitation of conditions a space vehicle faces upon re-entering the earth's atmosphere. Inside its test section, the behavior of materials and aerodynamic models can be checked and studied.

● THE ELECTRICAL ENGINEERING DEPARTMENT of Washington University School of Engineering, St. Louis, Mo., has received a $2500 generalized rotating machine from the Westinghouse Electrical Foundation. It will be used to teach student engineers the basic principles of converting mechanical energy to electrical energy, or of converting electrical energy to mechanical. The gift is part of a program whereby the Foundation is giving laboratory equipment valued at more than $500,000 to electrical-engineering departments throughout the country.

Fellowships and Scholarships

● A $25,000-aid-to-education program for outstanding students in six Eastern universities and colleges has been established by American Machine & Foundry Company, New York, N. Y. Schools to which the scholarships and fellowships will be awarded are: Princeton University, Harvard University, Dartmouth College, Massachusetts Institute of Technology, Cornell University, and Rensselaer Polytechnic Institute. Amounts granted to the schools will be determined after the scholarships and fellowships are awarded to the students. They will be given to leading students in the fields of mechanical engineering, electrical engineering, business administration, and chemistry.

● ONE THOUSAND high-school seniors throughout the nation have been named 1960 Merit Scholars. The Merit Scholarship Awards, financed by 110 companies, foundations, and other groups, and by the National Merit Scholarship Corporation which conducts the annual competition, will provide more than $4 million in scholarship assistance. The funds provided with each of the 830 four-year Merit Scholarships (170 Honorary Merit Scholars receive no money) vary according to the need of each individual winner, from a minimum of $100 to a maximum of $1500 a year.

● HIGHLY QUALIFIED graduate students in several engineering disciplines—civil, electrical, mechanical, chemical, and metallurgical—will be offered an opportunity to participate in the new Case Institute of Technology Engineering Design Center, an interdepartmental research and development laboratory. These Engineering Design Fellows, who form the main body of design teams which establish a program of research in or development of design problems, will receive a yearly stipend up to $3000 plus tuition, commensurate with the responsibility they assume. During the coming year, opportunities will be offered to 15 Fellows.

● THE NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS is establishing an Engineering Scholarship Board to administer its scholarship activities and to solicit additional scholarships from industrial and engineering firms. Currently the society is co-operating with the Armco Steel Corporation in the awarding of five $3000 four-year engineering scholarships to high-school seniors.

● THE HERTZ ENGINEERING SCHOLARSHIP FOUNDATION is a nonprofit private institution devoted to the granting of engineering scholarships to students interested in electrical, mechanical, and allied engineering fields. Mr. and Mrs. John Hertz inaugurated the scholarship in 1957 when it was made known that a large percentage of the nation's superior high-school students do not go to college even though an increased need for scientific and engineering manpower exists. The Foundation has awarded 68 scholarships since it was established. Dr. Edward Teller of the University of California, a director of the Hertz Foundation, has been director of a pilot plan to provide early consideration for engineering scholarships to highly able math-science students conducted recently in 60 San Francisco, Calif., Bay Area high schools. As a result, four high-school seniors have been awarded four-year scholarships. The range of grants has been $100-$2000 per year depending upon the student's need. Recipients of all scholarships must agree to make their engineering skills available to the Federal Government if called on during national emergency. A 12-page brochure revealing details of the Hertz Engineering Scholarship Foundation is available without charge from: Hertz Engineering Foundation, 1314 Westwood Blvd., Los Angeles 24, Calif.

Awards

● **Beckman Award.** The Instrument Society of America has announced the establishment of the Arnold O. Beckman Award, an annual award to an ISA member making the most important technological contribution to the conception and implementation of a new principle of instrument design, development, or application. Consisting of a citation and a cash award of $1000, the award was named in honor of Dr. Arnold O. Beckman, former president of the Society and one of its honorary members.

● **ASM Metals Awards.** The American Society of Metals has established three new Metals Awards: The William Hunt Eisenman Engineering Award will be presented each year for outstanding contributions in the practical application of the science of metallurgy to the production of metals or their engineering use. The William Hunt Eisenman Teaching Award, for outstanding teachers of metallurgy or related sciences, will be presented to a teacher of long-standing reputation through his ability to inspire students and impart enthusiasm and understanding. The Marcus A. Grossman Young Authors Award was established in honor of Dr. Grossman, a prolific author of metals texts and papers, to encourage creative writing by young metal scientists, and will be granted to authors under age 35 of the most outstanding paper in ASM Transactions.

MEETINGS OF OTHER SOCIETIES

● IN THE UNITED STATES

September 12-14

Human Factors Society, third annual meeting, Massachusetts Institute of Technology, Cambridge, Mass.

September 18-20

Steel Founders' Society of America, fall meeting, The Homestead, Hot Springs, Va.

September 19-22

Institute of Radio Engineers, national symposium on space electronics and telemetry, Shoreham Hotel, Washington, D. C.

September 21–22

Ninth Annual Symposium on Industrial Electronics, Cleveland-Manger Hotel, Cleveland, Ohio.

September 21–23

National Power Conference, sponsored by AIEE and ASME, Bellevue-Stratford Hotel, Philadelphia, Pa.

September 22

Society of Plastics Engineers, plastics in business machinery, Binghamton, N. Y.

September 25–28

AIChE, national meeting, Mayo Hotel, Tulsa, Okla.

September 26–28

AIEE, petroleum industry conference, Skirvin Hotel, Oklahoma City, Okla.

September 26–28

Standards Engineers Society, ninth annual meeting, Pittsburgh-Hilton Hotel, Pittsburgh, Pa.

September 26–28

American Management Association, fall personnel conference. The Henry Laurence Gantt Medal for 1960 will be awarded jointly by AMA and ASME at the concluding session. Statler-Hilton Hotel, New York, N. Y.

September 26–29

American Welding Society, national fall meeting, Penn-Sheraton Hotel, Pittsburgh, Pa.

September 26–30

Instrument Society of America, instrument-automation conference and exhibit, New York Coliseum, New York, N. Y.

September 27–30

Association of Iron and Steel Engineers, annual convention, Public Auditorium, Cleveland, Ohio.

October 2–5

AIME, fall meeting, Denver, Colo.

October 3–5

Institute of Radio Engineers, national communications symposium, Utica Hotel and Utica Memorial Auditorium, Utica, N. Y.

October 3–7

Tenth Annual Instrument Symposium (Oct. 3–6) and Research Equipment Exhibit (Oct. 4–7), National Institutes of Health, Bethesda, Md.

October 4–7

Eighth Annual Human Engineering Institute, Dunlap and Associates, Inc., Stamford, Conn.

October 9–14

AIEE, fall general meeting, Morrison Hotel, Chicago, Ill.

October 10–12

Operations Research Society of America, national meeting, Statler-Hilton Hotel, Detroit, Mich.

October 10–14

American Society of Civil Engineers, annual convention, Boston, Mass.

October 10–14

Society of Automotive Engineers, national aeronautic meeting, manufacturing forum and engineering display, Ambassador Hotel, Los Angeles, Calif.

October 11–14

Industrial Management Society, executive techniques for industrial engineering seminar (Oct. 11–14), Congress Hotel, Chicago; and industrial engineering and management clinic (Oct. 13–14), Conrad Hilton Hotel, Chicago, Ill.

October 13–14

American Welding Society, New England regional welding conference, Commonwealth Armory, Boston, Mass.

October 14–15

American Society for Quality Control, 15th Midwest Conference, Broadview Hotel, Wichita, Kan.

October 15

American Society of Safety Engineers, annual meeting, Conrad Hilton Hotel, Chicago, Ill.

• IN ARGENTINA

September 12–22

Congress on Engineering Education (Sept. 12–17), and UPADI, sixth convention (Sept. 19–22), Buenos Aires.

• IN EUROPE

September 16–20

Société Hydrotechnique de France, symposium on "Hydraulic Turbine Research," Nice, France.

September 20–October 7

International Atomic Energy Agency, fourth general conference, Vienna, Austria.

September 21–23

VDI, Commission for Clean Air, Questions on Clean Air, Wiesbaden, West Germany.

September 26–October 1

AGARD-NATO, structures and materials panel, Athens, Greece.

September 27–October 1

National Center of Scientific Research, internation symposium on the physics of electrostatic forces and their applications, Institute Fourier, Grenoble, France.

October 2–5

VDI, Society for Chemical Engineering in the Association of German Engineers, Mannheim, Germany.

October 3–4

AGARD-NATO, fluid dynamics panel on industrial uses of wind tunnels, Istanbul, Turkey.

October 3–4

AGARD-NATO, flight mechanics panel on manned ballistics and weapons systems testing, Istanbul, Turkey.

October 3–8

AGARD-NATO, aerospace medical panel on clinical problems in aviation medicine and space flight problems, Istanbul, Turkey.

October 3–8

AGARD-NATO, panel on navigation, Istanbul, Turkey.

October 6–7

AGARD-NATO, tenth general assembly, Istanbul, Turkey.

October 10–12

International Congress on the Technology of Plastics Processing, sponsored by the Association for the Advancement of the Knowledge of Materials, the Royal Institute of Engineers, and the Royal Netherlands Chemical Federation, Amsterdam, The Netherlands.

Mid-October

VDI-Fachgruppe Vibration Engineering, vibration conference, Essen, Germany.

October 17–19

K.I.v.I., International Congress on Plastics, Amsterdam, The Netherlands.

October 20–21

VDI-AWF-Fachgruppe Gear Engineering, international conference on gearing, Essen, Germany.

(*For ASME Coming Events see page 117.*)

I. MECH. E. MEETINGS

September 27–28

Symposium on Automatic Control, British contribution to first international congress of IFAC held in Moscow in 1960. London, England.

November 9–10

The Use of Secondary Surfaces for Heat Transfer With Clean Gases, symposium, apply for registration at The Institute, London, England.

January 18, 1961

Pressure Vessel Research Toward Better Design, symposium, apply for registration at The Institute.

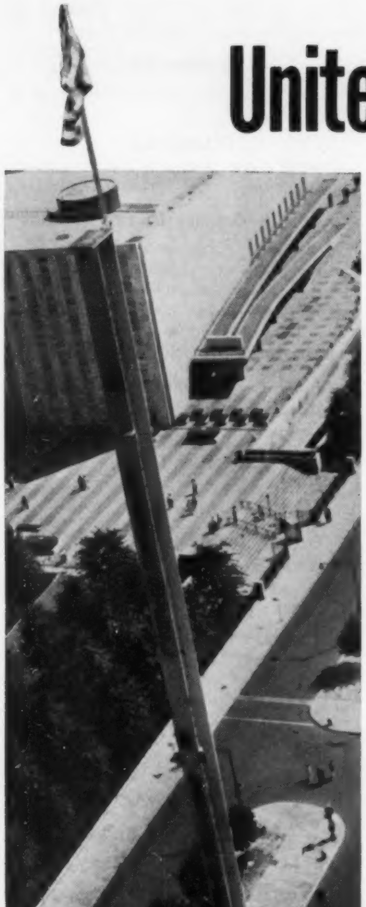
March 1, 1961

User Experience of Large-Scale Industrial Vacuum Plant, symposium, London.

→*Note:* The foregoing calendar of The Institution of Mechanical Engineers (Great Britain) meetings is published as a service to members of ASME. Further information relating to complete programs and available papers may be obtained from The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London, S. W. 1, England. Preliminary programs also are published in *The Chartered Mechanical Engineer* (I.Mech.E.) which is on file in the Engineering Societies Library, 29 West 39th Street, New York 18, N. Y., and other libraries throughout the United States and Canada.

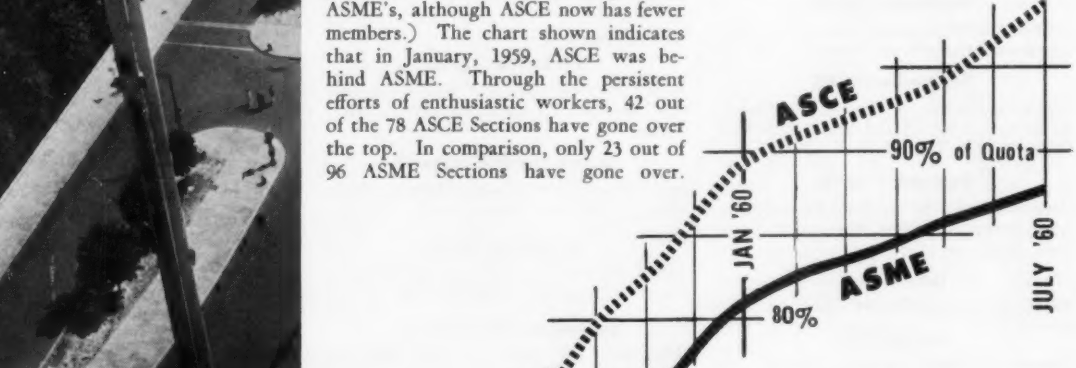
United Engineering Center

ASME FAR SHORT OF QUOTA



Flag flies from highest UEC column. Dreier Structural Steel Company observes an old tradition by holding topping-out ceremony.

RESULTS achieved to date in the ASME Member Gifts Campaign have been most disappointing. The Campaign now has been in progress for more than two years and ASME has reached only 87.4 per cent of its quota of $800,000. As a Society, we should remind ourselves that the American Institute of Chemical Engineers reached its quota in May, 1959, over a year ago. If the newest member of the United Engineering Trustees can do its part, certainly ASME can do likewise. The American Society of Civil Engineers has done a fine job over the past 18 months and has now reached 98.7 per cent of its quota of $800,000. (This is the same quota as ASME's, although ASCE now has fewer members.) The chart shown indicates that in January, 1959, ASCE was behind ASME. Through the persistent efforts of enthusiastic workers, 42 out of the 78 ASCE Sections have gone over the top. In comparison, only 23 out of 96 ASME Sections have gone over.



There is no reason whatsoever why ASME cannot do as well as ASCE. It should be noted that 14 ASME Sections have less than $1000 to raise in order to reach their quotas.

Many comments have been heard about problems and difficulties faced in raising the funds necessary to construct the United Engineering Center. While some ASME Sections, through the efforts of their Campaign teams, have been successful in exceeding their quotas, others have not done so well. Some Section Campaign Chairmen have offered the excuse that the new Center is too remote from their geographical locations; however, note that Northwest Florida, Hawaii, San Diego, and Columbia Basin (Pacific Northwest) are all over 100 per cent. Again, chairmen in large Sections and in small Sections have claimed that the size of their respective memberships was detrimental to success; however, note that Detroit (1149), Metropolitan (5207, including North Jersey and Long Island), Olean (121), and Fort Wayne (81) are all over 100 per cent. Success in the Campaign does not depend on geography, number of members in a Section, regional attitudes, population density, or type of industry concentration. Success does depend on leadership, organization, personal contacts by solicitors, and persistent follow-up. Every Section will reach its quota when leaders accept their responsibilities and decide that the job must be done.

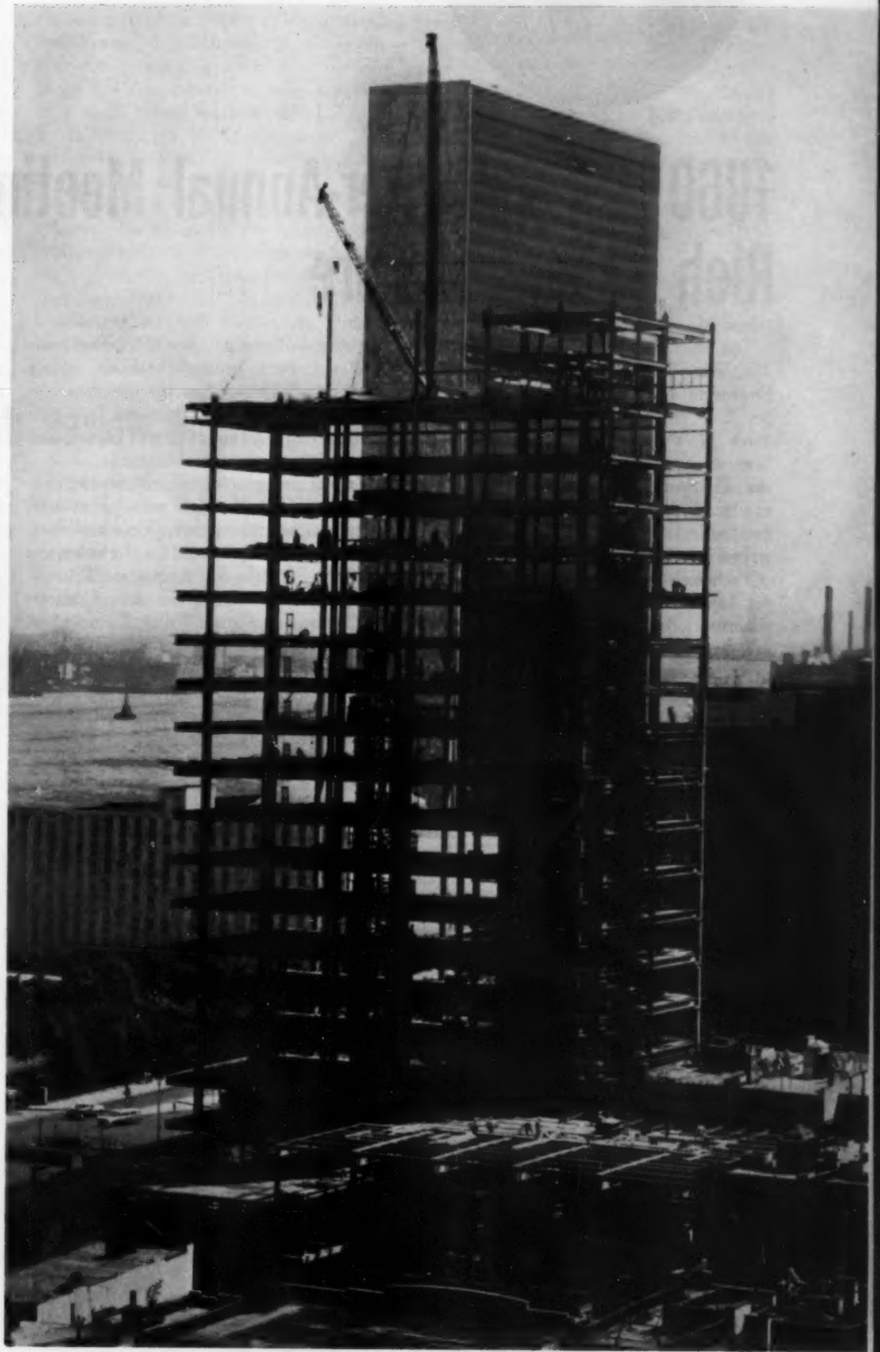
Members who are waiting to be contacted in order that they can make their pledges, or even increase those already made, should make this fact known to their chairmen by telephone or by mail. If a member does not know the name of his chairman, he should write or call the ASME, 29 West 39th Street, New York 18, N. Y.—PEnnsylvania 6-9220.

Per Cent of Quota	Section	Dollars Short of Quota
180.8	Waterbury	
164.0	Cincinnati	
149.6	Canton-Alliance-Massillon	
143.8	Dayton	
143.0	Northwest Florida	
136.0	Hudson Mohawk	
130.6	West Virginia	
130.0	Youngstown	
128.0	Worcester	
124.1	Atlanta	
116.0	Detroit	
115.9	Hawaii	
112.8	Providence	
112.0	Columbia Basin	
111.1	Metropolitan (includes North Jersey and Long Island Sections)	
111.1	Birmingham	
105.9	Westmoreland	
105.1	Olean	
105.0	Central Indiana	
104.7	Central Iowa	
102.4	Southern Tier	
102.3	San Diego	
100.0	Fort Wayne	
	SHORT OF QUOTA	
94.7	Inland Empire	49
97.8	Erie	97
90.2	North Alabama-Mississippi	230
89.9	Sabine	238
87.0	Rock River Valley	514
67.2	New London	747
80.5	Iowa-Illinois	755
84.0	Piedmont-Carolina	760
59.1	Gulf Coast	762
78.0	Mid Hudson	853
70.4	Nebraska	863
93.6	Milwaukee	899
90.0	Fairfield County	935
27.6	Paducah	970
85.2	Rochester	1,007
52.4	Utah	1,010
66.4	Central Savannah River Area	1,023
39.6	Miami	1,051
8.3	Palm Beach	1,100
55.2	Central Michigan	1,119
42.4	Greenville	1,232
70.9	Susquehanna	1,233
42.5	Central Kansas	1,264
85.7	Anthracite Lehigh Valley	1,266
85.4	Minnesota	1,300
29.6	Savannah	1,324
40.4	Mexico	1,336
32.5	Mohawk Valley	1,403
82.2	Columbus	1,405
57.1	Eastern Virginia	1,408
67.0	Toledo	1,504
0.9	North East Florida	1,585
33.2	Idaho-Montana	1,617
82.9	Kansas City	1,674
64.1	Syracuse	1,715
43.4	Oregon	1,790
54.5	New Haven	1,883
88.2	Cleveland	1,940
	MORE THAN $2000	
91.5	Pittsburgh	2,072
79.7	Delaware	2,093
62.4	East Tennessee	2,108
51.4	Arizona	2,109
22.1	Central Pennsylvania	2,150
69.6	Akron	2,161
50.5	Western Massachusetts	2,336
24.8	Eastern North Carolina	2,360
56.8	Central Illinois	2,557
15.6	Central Virginia	2,719
23.6	Virginia	2,951
18.3	St. Joseph Valley	3,054
23.7	Louisville	3,127
31.0	Florida	3,284
41.4	New Mexico	3,607
58.5	Western Washington	4,007
15.7	Northern New England	4,250
17.4	Chattanooga	4,594
	MORE THAN $5000	
30.5	Rocky Mountain	5,004
62.3	Baltimore	5,021
34.6	Buffalo	5,115
48.8	St. Louis	5,757
24.0	New Orleans	6,309
34.2	Ontario	6,901
33.5	Mid-Continent	7,027
53.2	Mid Jersey	7,828
34.1	Hartford	7,879
40.2	South Texas	9,115
24.7	North Texas	9,407
34.6	Washington, D. C.	9,625
59.9	Boston	11,936
68.8	Chicago	13,499
40.9	San Francisco	18,264
50.9	Philadelphia	21,193
29.0	Los Angeles	36,292

◄ **Your Section's Score as of Aug. 1, 1960**

Topping-out Ceremony

As breeze catches American flag atop it, the highest column for UEC is lowered into place, and the steel structure of building nears completion. Part of UN is shown in background. Brief topping-out ceremony held July 26, 1960, which marked the event, was attended by officials of societies which will occupy the Center.



Notes on
Society Activities
and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

1960 ASME Winter-Annual Meeting Promises Rich Technical Fare

THE 1960 Winter-Annual Meeting of The American Society of Mechanical Engineers, November 28 through December 2, at the Statler Hilton Hotel, New York, N. Y., offers an extremely comprehensive program. Even in its present skeletal form it embraces the ever-growing number of avenues of interest to the mechanical engineer and engineers engaged in allied fields.

Technical Program. The five-day technical program will be presented in 126 sessions. As we go to press, 170 papers are processed or in the process of being prepared for the Meeting. By the time the Meeting opens on November 28, more than 350 papers will have been prepared. To accomplish this vast work requires the co-operation of 32 ASME Professional Divisions and committees.

In addition to panel discussions on fuels, nuclear engineering, and safety; hydraulic symposiums, and a colloquium on shock and structural response; a ten-year report on management, there will be papers by leading authorities in the fields of applied mechanics, aviation, fuels, hydraulics, nuclear engineering, materials handling, production engineering, lubrication, safety, heat transfer, gas-turbine power, machine design, oil and gas power, metals engineering, petroleum, power, solar energy, maintenance, instruments and regulators, process industries, and railroads.

Committee contributions deal with fluid meters, education, human factors in engineering, corrosion and deposits from combustion gases, and power test codes as well as a professional practice panel on "Free Engineering."

How broad the coverage will be may be estimated from a sampling of aviation papers which will discuss topics including the following: Rocket power, airline transport ground-checkout equipment, ground-based radar antenna design, heavy presses, control of gas-turbine engines, novel power plants, and ultra-high-pressure development.

Safety and people, radioisotopes in industry, and industrial ventilation will keep the safety engineers on their toes. A film has been prepared for the attention of all engaged in the ventilation field entitled "Roof-Ventilation Requirements for Industrial Plants."

In heat-transfer sessions the discussions will take up applications, change of phase, boundary layer and related topics, and forced convection. Special conferences have been scheduled for conduction, convection, and radiation.

Railroad papers take into consideration progress in railway mechanical engineering at home and abroad and the technical aspect of push-pull-type suburban cars.

Nuclear Blast Problems. On Wednesday, November 30, the Applied Mechanics Division will present a colloquium on shock and structural response. It has been planned particularly to help the designer who is confronted with the problem of design for nuclear blasts, but should be useful as well to designers in other shock situations. The speakers, Y. C. Fung, Irvin Vigness, C. E. Crede, Dana Young, and M. W. Barton, will discuss: Impact, shock pulses, and response spectra; measurement of shock; concepts of shock-treating of equipment; response of structural systems to ground shock; and ground shock and missile response, respectively. A booklet is in preparation to include all five papers and is expected to be available by November 1 from the ASME Order Department as well as at the Meeting.

Heat-Transfer Symposium. A four-session symposium on theory and fundamental research in heat transfer, sponsored by the Heat Transfer Division, will be presented November 28 and 29. The purpose of the symposium is to give an evaluative survey of the present status in this and related areas of theory and fundamental research, discuss unresolved problems in the field, and to examine critically those directions in which future research is needed and where it might be directed profitably.

Eleven recognized authorities have been invited to deliver a lecture, each on a different phase of the subject, thus to insure a successful accomplishment of the purpose. Subsequent to the symposium the lectures will be published by ASME. The final session of the symposium will be a panel discussion with the lecturers participating as panelists. The lecturers and their topics follow: R. F. Probstein, "Heat Transfer in Rarefied Gas Flow"; Nils Frössling, "Problems of Heat Transfer Across Laminar Boundary Layers"; W. V. R. Malkus, "A Theory of Turbulent Convection"; R. J. Monaghan, "Boundary-Layer Development Under Pressure Gradients With Particular References to Heat Transfer"; F. Schultz-Grunow, "Turbulent Heat Transfer in Stratified Flow"; James A. Krumhansl, "Transport of Thermal Energy in Solids"; James W. Westwater, "Things We Don't Know About Boiling Heat Transfer"; S. S. Penner, "Recent Studies on Quantitative Spectroscopy and Gas Emissivities"; H. C. Hottel, "Gaseous Radiation With Temperature Gradients"; R. V. Dunkle, "Thermal Radiation Characteristics of Surfaces"; and Howard W. Emmons, "Plasma Heat Transfer."

Management—Ten-Year Progress Report.

The 1950–1960 report on "Progress in Management" is scheduled for presentation in five sessions. Leading off with "Management's Past—A Guide to the Future," by L. M. Gilbreth and W. L. Jaffe, the philosophy of management will be discussed by L. F. Urwick and A. M. Lederer. Management as a profession will be developed by H. F. Smiddy, and practices in general management will be divided into three parts: Organizational, by B. J. Muller-Thym; financial, R. B. Curry; and controls-measurement, A. W. Rathe. The practices in operational management dealing with six phases will be presented as follows: Research management, by H. Work and A. B. Kinzel; engineering management, C. E. Paules; manufacturing management, H. B. Maynard; personnel management, C. E. French; distribution management, J. R. Hawkinson; and Government and other nonprofit organization management, G. M. Goettelman. E. H. Weinwurm will discuss management science, and management education will be the work of E. P. Brooks, C. E. Davies, and F. F. Bradshaw. The international progress in management reports will be given by E. Mittlesten-Scheid. Peter F. Drucker's contribution deals with future trends in management.

At the Meeting it is planned to offer for sale pamphlet copies of the individual papers. In addition, the entire current report together with the four previous ten-year reports will be available in a cloth-bound books entitled, "Fifty Years' Progress in Management." It will sell for $8.40 to ASME members; $10.50 to nonmembers.

Social Events. The calendar of social events is sparkling, but too lengthy to do more, at this time, than to list the following: Monday, President's Luncheon; Tuesday, Fuels and Machine Design Luncheons, Applied Mechanics Dinner; Wednesday, Management Luncheon and Towne Lecture, Metals Engineering Luncheon, and Hydraulic Dinner; Thursday, Members and Students Luncheon and the Banquet.

Women's Program. As usual, the program for the women is extensive and packed to bursting. Starting off with an Early Bird Party at Carnegie Foundation (one square from the site of the new United Engineering Center), it includes a tea dance on Tuesday, and so on. However, the pièce de résistance is that there will be available tickets Wednesday evening, November 30, for Mary Martin's hit vehicle, "Sound of Music," which has been an outstanding show of the season. The committee, ever conscious of real needs, advises that baby-sitter service is available. Tickets for the show will be sold "first-come first-served" . . . your check made payable to ASME should be sent to Mrs. J. J. Moro-Lin, 22 Beverly Road, Glen Rock, N. J. Orchestra seats are $10.50; balcony seats, $8.25.

Power Show to Review Methods of Plant Integration

Methods of plant integration will be extensively reviewed by exhibits at the 24th National Exposition of Power and Mechanical Engineering, under the sponsorship of The American Society of Mechanical Engineers, lending emphasis to the trend toward bigger and better plants in all branches of industry.

Displays will feature materials and equipment covering the entire scope of power production and the distribution and use of energy in various forms by all industries. A noteworthy aspect of most displays will be direct provision for the absorption of equipment into a unified plant design. The ultimate expression of this objective will often be found in provisions for automation.

The Exposition will provide a forum for designers and engineers in conjunction with the Winter-Annual Meeting of the Society. It will be presented at the New York Coliseum, November 28 to December 2.

Exhibits at the Coliseum will broadly feature means for fluid transfer. In nearly all plants great quantities of water, oil, and chemicals are pumped, metered, and controlled, and many examples of pumps, piping, valves, and regulating devices will be shown.

Of special interest will be new methods for designing networks of piping, revealing the advance of specialization into the piping field. One exhibitor will offer high-temperature, high-pressure alloy and carbon-steel piping produced in a newly completed plant specializing in equipment for electric-generating stations. Another will offer "job-matched" stainless tubing, matching quality, quantity, and timing to the plans and specifications of customers' projects.

Single-source responsibility for a single segment of plant design and construction will be further demonstrated by an exhibitor offering complete industrial air service. This service includes complete air conditioning, air-pollution control, the handling of air and gases for process purposes, and also the transfer of dry materials for processing as well as the removal of wastes, such as dusts and shavings.

Another exhibitor, also prepared to assume responsibility for an entire area in the plant, is prepared to provide the complete instrument requirement, including primary sensing devices, indicators, loggers, control units, panels, data-handling equipment, computers for performance analysis, and supervisory controls.

The display of instruments for power and process control will be comprehensive and many items in this section of the show will be well out in front of the field.

Many displays will be devoted to single-purpose units, such as motors, drives, power transmissions, pumps, fans, and blowers among them. The array of

Women's program is in good hands. **Left to right,** are: Mrs. William Hausmann, chairman, Metropolitan section; Mrs. Erik Oberg, General Chairman, Women's Activities at Annual Meeting; and Mrs. W. H. Byrne and Mrs. J. C. Gibb, vice-chairmen.

valves will be comprehensive and include many special designs. Means of valve operation will include solenoids capable of operating at temperatures up to 400 F and motorized operators powerful enough to move the largest gates. Electrification permits centralized control, and complete control systems will be offered that will enable one man to supervise the operation of an entire plant.

Auxiliary devices on view will include flow valves that not only indicate the movement of fluids but may be made to stop or start fluid movement in piping systems automatically. Expansion joints for use wherever there is movement in piping and a variety of hangers and supports will be shown. Specially designed supports will be displayed for application where reactive forces at terminal points must be limited to prevent overstressing connected equipment.

The fusing of pressure systems by means of rupture disks has been advanced to a point of high precision in view of increasing high pressure and explosion hazards. Because under modern operating conditions an extreme pressure rise may occur within milliseconds, emergency rupture disks are now designed to burst instantly at critical pressure points.

Heat-transfer apparatus will be shown in good variety including a number of auxiliary units. One such is an instantaneous heater for water, oil, or other liquids, operated by steam. Another is a compressed air aftercooler.

In line with the trend toward improving the appearance of industrial plants, especially those adjoining residential areas, an exhibitor of air-cooled condensers offers a fin-tube roof coil of attractive design, having a low silhouette. In addition to its architectural value this has the advantage that, due to its circular form, it literally always faces the wind.

A manufacturer of glass-protected smokestacks offers them in seven different colors so they may harmonize with building exteriors, as well as providing superior durability.

The 24th National Power Show will be under the management of the International Exposition Company, 480 Lexington Avenue, New York 17, N. Y. E. K. Stevens, president of the Company, is manager of the Exposition.

ASME West Coast Applied Mechanics Conference Continues General Lecture Tradition

THE 1960 West Coast Conference of Applied Mechanics was held at the California Institute of Technology, Pasadena, Calif., during June 27–29, 1960. As usual, it was sponsored jointly by the Applied Mechanics Division of The American Society of Mechanical Engineers and the Engineering Mechanics Division of the American Society of Civil Engineers. An attendance of approximately 150 scientists from all over the United States indicated, once more, the high degree of widely drawn interest.

As in the previous year at Stanford University, the high lights of the Conference were the two invited General Lectures by outstanding scientists. Prof. J. N. Goodier, Mem. ASME, of Stanford University, presented an up-to-date lucid address on "Engineering Applications of the Theory of Finite Elastic Deformation"; he included some of his personal original work by which he has laid sound theoretical foundation to previous analyses based to a certain extent on scientific intuition. The other General Lecture on the subject "Stress-Strain Relations in Plasticity" was delivered by Prof. Paul M. Naghdi, Mem. ASME, of the University of California, Berkeley, who offered a rigorous theoretical treatment of the fundamentals of the theory of plasticity. An effort is being made to publish annually the General Lectures of both the regular Annual Conference and the West Coast Conference in a bound volume.

The technical papers presented at the Conference covered a wide range of subjects including elasticity, viscoelasticity, plasticity, viscoplasticity, wave propagation, and dynamics, and were listed in the program published in the June, 1960, issue of MECHANICAL ENGINEERING, p. 120. Availability list of papers also was given in the August, 1960, issue of the same publication, p. 113.

During the Conference new officers of the West Coast Committee of the Applied Mechanics Division for the year 1960–1961 were elected. Prof. George A. Zizicas, Mem. ASME, of the University of California, Los Angeles, will serve as chairman of the Committee. Prof. Julius Miklowitz, Mem. ASME, of the California Institute of Technology, is the new Secretary. Prof. Paul M. Naghdi, Mem. ASME, of the University of California, Berkeley, was recommended as a new member of the Committee. The remaining two of the total of five members are: W. A. Gross, Mem. ASME, of International Business Machines, San Jose, Calif.; and J. G. Berry, Mem. ASME, of Space Technology Laboratories, Los Angeles, Calif.

The Committee has decided to hold the next West Coast Conference of Applied Mechanics at the University of Washington, Seattle, Wash., Aug. 28–30, 1961. This choice will extend the range of meeting places for the Conference along the entire West Coast. ASME members are urged to plan to attend the Seattle Conference in late August, 1961, and combine it, possibly, with a vacation for the entire family in one of the most scenic parts of the U. S. at the time when it is especially cool and pleasant.

Leaders of the Western Conference. In **left** photo, **left to right**, front row, P. M. Naghdi, General Lecturer; S. B. Batdorf, chairman, Executive Committee, Applied Mechanics Division; W. A. Gross; J. N. Goodier, General Lecturer. Back row, J. Miklowitz, incoming secretary of the West Coast Committee, Applied Mechanics Division; G. A. Zizicas, incoming chairman; W. Goldsmith, outgoing chairman; K. S. Pister, ASCE; B. J. Hartz, ASCE; T. H. Lin, ASCE. In photo, **right**, a view of the coffee break from the Registration Desk.

Call for Agenda Items for 1961 RAC Meetings

The 1961 Agenda Committee extends an invitation to every member of ASME to offer suggestions and improvements in the operations of the Society. This invitation is a step in the democratic process by which the membership and the Sections impart their ideas to the Council.

Please word your proposed items so that they are clear and specific and so that there will be no misunderstanding as to intent. Also, be sure the wording is positive so that action can be taken either to "accept" or "reject" the item as worded. Accompany each item with a short statement as to why you feel the item should be approved.

All agenda items are to be submitted in accordance with the following form, *and should be sent to the Secretary of your Section not later than Oct. 1, 1960.*

The Agenda Committee of each Section will screen these items against items previously considered by the Council, and forward the items to the National Agenda Committee not later than Nov. 1, 1960.

If you lack the address of your Section Secretary, you may send your items, *not later than October 1, to the ASME Agenda Committee, 29 West 39th Street, New York 18, N. Y.*

ASME Agenda Item

Proposed by.........................of the.......................Section

Address...

Date..............................   ....
Signature

Item: It is proposed that.....

Proposer's Comment:

ASME-AIME Joint Solid Fuels Conference in West Virginia

Economics in the production and utilization of coal will be the theme of this year's annual Joint Solid Fuels Conference to be held Oct. 24–25, 1960, in the Daniel Boone Hotel, Charleston, W. Va. Sponsors for the twenty-third meeting are the Fuels Division of The American Society of Mechanical Engineers and the Coal Division of the Society of Mining Engineers of AIME. The Society of Mining Engineers is a constituent organization of the American Institute of Mining, Metallurgical and Petroleum Engineers.

The two national engineering societies, ASME and AIME, stage this conference jointly each year, alternating as hosts. ASME is host this year.

The program for this year's meeting is comprised of three sessions, the first and second on Monday, and the third on Tuesday morning. The first session will be sponsored by AIME, and the other two sessions by ASME.

The Honorable Cecil H. Underwood, Governor of the State of West Virginia, and Stephen F. Dunn, President of the National Coal Association, will be guest speakers on the Conference program.

The annual presentation of the Percy Nichols Award will be made at the Conference banquet on October 24.

Several plant tours are being arranged for Tuesday afternoon for those attending the Conference interested in visiting one of several Kanawha Valley enterprises. The following lists the various alternatives: Union Carbide Technical Center, Carbon Fuel Company Mechanized Mine, Kanawha River plant of Appalachian Power Company, and Union Carbide Automatic "Sunshine" Mining Operation.

In addition, a separate program for the women attending the Conference is being prepared, including a trip through the Blenko Glass Company, Milton, W. Va., and a tour through the State Capitol.

▶MONDAY, OCTOBER 24

Session 1 **9:30 a.m.**

Chairman: *D. Davis*, Mountaineer Coal Co., Fairmount, W. Va.
Vice-Chairman: *A. E. Spotte*, Princess Coal Sales Co., Huntington, W. Va.

Mechanical Mining in Low Seam (28–36 In.) Mines,[1] by *C. Storey*, Princess Elkhorn Coal Div., Princess Coal Inc., David, Ky. (AIME Paper)

What Industrial Consumers Look for in Purchasing Coal,[1] by *D. M. Given*, Union Carbide Corp., New York, N. Y. (ASME Paper)

The Suppliers Viewpoint in Selling Coal,[1] by *C. R. Mabley, Jr.*, Island Creek Coal Sales Co., Huntington, W. Va. (ASME Paper)

Session 2 **2:00 p.m.**

Chairman: *M. L. Jones*, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.
Vice-Chairman: *R. W. Precious*, Union Carbide Corp., Charleston, W. Va.

A Decade of Electric-Utility Fuel Experience, by *M. E. Robinson* and *W. L. Kurtz*, National Coal Association, Washington, D. C. (ASME Paper No. 60—Fu-1)

New Concepts—Coal From Mine to Industrial Boilers,[1] by *C. E. Day*, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. (ASME Paper)

A Concept of Combustion Control for Firing Two Solid Fuels,[1] by *C. E. Rodenburg*, Rust Engineering Co., Pittsburgh, Pa. (ASME Paper)

▶TUESDAY, OCTOBER 25

Session 3 **9:00 a.m.**

Chairman: *J. B. Walker, Jr.*, The Babcock & Wilcox Co., Barberton, Ohio
Vice-Chairman: *H. C. Skaggs, Jr.*, Appalachian Power Co., Charleston, W. Va.

Volatile Matter in Coal and Its Relation to Pulverized Coal-Fired Units,[1] by *J. F. Mullen*, Combustion Engineering Co., Windsor, Conn., and *G. Gould*, Fuel Engineering Co., New York, N. Y. (ASME Paper)

The Comparison of Sulfur Analyses by Combustion Tube and Eschka Methods Using Coals From Various Seams and of Varying Sulfur Content,[1] by *E. J. Sandy*, West Virginia Univ., Morgantown, W. Va. (ASME Paper)

Present Status of Underground Gasification of Coal in USSR,[1] by *C. D. Pears*, Southern Res. Inst., Birmingham, Ala. (AIME Paper)

[1] Paper not available—see box on this page.

Availability of Papers

ASME Papers

Only numbered ASME papers in this program are available in separate copy form until Aug. 1, 1961. Prices are 50 cents to members of ASME; $1 to nonmembers, plus postage and handling charges. You can save the postage and handling charges by including your check or money order made payable to ASME with your order and sending both to ASME Order Department, 29 West 39th Street, New York 18, N. Y. Payment also may be made by free coupons, or coupons which may be purchased from the Society in lots of ten at $4 to members; $8 to nonmembers. Papers must be ordered by the paper numbers listed in this program, otherwise the order will be returned. The final listing of available technical papers will be found in the issue of Mechanical Engineering which contains an account of the Conference.

AIME Papers

Copies of AIME papers can be obtained by writing directly to: Preprints, Society of Mining Engineers of the American Institute of Mining, Metallurgical and Petroleum Engineers, 29 West 39th Street, New York 18, N. Y. Prices are 50 cents to members and $1 to nonmembers. Papers must be ordered by the paper numbers listed in this program, otherwise the order will be returned.

ASME CODES AND STANDARDS WORKSHOP

Milling Machine Spindle Noses and Arbors

By C. T. Blake, Chairman B5 TC/4

The 1960 edition of B5.18 American Standard on Milling Machine Spindle Noses and Arbors has just been issued to supersede ASA B5.18–1953. A new spindle nose size, designated by 50A has been added at the suggestion of the American Society of Tool Engineers to reflect growing use of flat back cutters for production milling. Other detail changes and corrections in the tables and drawings have been made at the request of a special committee of 15 milling maching manufacturers appointed by National Machine Tool Builders' Association to reflect more accurately current actual practice. In addition, the method of dimensioning radial hole locations has been changed to follow the principles set forth in American Standards Manual on Dimensioning and Notes (ASA Y14.5–1957).

Copies are available from ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Errata Sheet for ASA B18.2–1960 Square and Hexagon Bolts and Nuts

P. 8 Change first line of asterisk note as follows: "There may be a reasonable swell or fin under the head or die seam on the body not to exceed the nominal body diameter by the following":

P. 13 Transpose the values on last two columns of table (Max, Min Radius of Fillet).

P. 15 Column 6: Change title to "Root Diameter D1."

P. 15 Detail of thread form (lower right hand figure): Change "R" to "D1" and reverse dimension line with arrow pointing up rather than down.

P. 15 End of footnote starting "Minimum thread length...": Change "practical" to "practicable."

P. 17 Under Nominal "Thickness Jam Nuts," sixth line: Change "$^{6}/_{16}$" to "$^{5}/_{16}$."

P. 21 Third line, fourth column: Change "0.5265" to "0.5625."

P. 22 Last line of asterisk note: Change "page 18" to "page 17."

P. 23 First line in the break of the table: Change "page 18" to "page 17." Asterisk note: Change "page 18" to "page 17."

P 24 First line in the break of the table: Change "page 19" to "page 18." Asterisk note: Change "page 19" to "page 18."

P. 29 In the "Heavy Bolts" column add "$2^{3}/_{4}$" for a nominal size of wrench of $4^{1}/_{4}$.

In the "Finished Bolts" column add "$3^{1}/_{4}$" for a nominal size of wrench of $4^{7}/_{8}$.

Transpose the following sizes from the "Heavy Nuts" column to the "Finished and Regular Bolts" column:

$3^{1}/_{2}$, for a nominal size of wrench of $5^{1}/_{4}$.
$3^{3}/_{4}$, for a nominal size of wrench of $5^{5}/_{8}$.
4, for a nominal size of wrench of 6.

P. 33 Appendix III: Delete both paragraphs.

Change "Screw" to "Bolt" in D and L on both figures.

Note: Extra copies are available from the ASME.

ASME-ASLE Seventh Annual Lubrication Conference, October 17–19, in Boston

The Seventh Annual Lubrication Conference, jointly sponsored by The American Society of Mechanical Engineers and the American Society of Lubrication Engineers, will be held at the Statler-Hilton Hotel in Boston, Mass., Oct. 17–19, 1960.

This Conference provides a principal forum for presentation and discussion of developments in the fields of bearings, gears, seals, and the lubrication thereof. From jet engines and space vehicles to atomic power plants, progress is being made involving difficult practical problems. And, in university and industrial research laboratories, investigations of basic mechanisms are adding pieces to the puzzles of rubbing phenomena. Papers contributing to these and other areas are included among the 30 to be presented in eight sessions.

The Statler-Hilton Hotel is centrally located in Boston. Many attractions in Boston are nearby, as are M.I.T. and Harvard.

▶MONDAY, OCTOBER 17

Session 1 **10:00 a.m.**

Surface Films in Lubrication

Chairman: *J. H. Schulman*, Columbia Univ., New York City

Vice-Chairman: I-M. Feng, Ethyl Corp., Detroit, Mich.

Adsorption of Polar Organic Molecules on Machined Metal Surfaces and Properties of the Resulting Surface Films,[1] by *H. A. Smith* and *R. L. Bennett*, Univ. of Tennessee, Knoxville, Tenn.

Lubrication at High Temperatures With Vapor Deposited Surface Coatings, by *D. J. Baldwin* and *G. W. Rowe*, Tube Investments Res. Labs., Cambridge, England. (ASME Paper No. 60—Lub-4)

Inhibiting Corrosive Wear in Lubrication With Halogenated Gases at 1500 F by Use of Competitive Reactions and Other Methods, by *D. H. Buckley* and *R. L. Johnson*, NASA Lewis Res. Center, Cleveland, Ohio. (ASLE Paper No. 60—LC-1)

[1] ASME Paper not available—see box on this page.

Session 2 **2:00 p.m.**

Gear Lubrication

Chairman: *L. J. Collins*, Gen. Elec. Co., Lynn, Mass.

Vice-Chairman: *V. S. Wagner*, DeLaval Steam Turbine Co., Trenton, N. J.

Instantaneous Coefficients of Gear-Tooth Fric-

Availability of Papers

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tion, by *G. H. Benedict* and *B. W. Kelley*, Caterpillar Tractor Co., Peoria, Ill. (ASLE Paper No. 60—LC-2)

Experience With Scuffing—Tests on Gear Oils in Back to Back Rigs, by *G. Niemann, H. Rettig*, and *G. Lechner*, Technische Hochscyle, Munchen, West Germany. (ASLE Paper No. 60—Lub-3)

Gear and Bearing Lubrication in Extreme Environments With Polyphenyl Ethers, by *J. B. Accinelli, V. N. Borsoff, W. W. Kerlin*, and *S. J. Beaubien*, Shell Development Co., Emeryville, Calif. (ASME Paper No. 60—Lub-8)

The Volume of Stressed Material Involved in the Rolling of a Ball, by *R. C. Drutowski*, Res. Labs. Gen. Motors Corp., Warren, Mich. (ASME Paper No. 60—Lub-7)

▶TUESDAY, OCTOBER 18

Session 3-A 9:00 a.m.

Unusual Environments

Chairman: *H. E. Mahncke*, SKF Industries, Philadelphia, Pa.

Vice-Chairman: *M. B. Peterson*, Gen. Elec. Co., Schenectady, N. Y.

Evaluation of Ball-Bearing Separator Materials Operating Submerged in Cryogenic Liquids, by *W. A. Wilson, K. B. Martin, J. A. Brennan*, and *B. W. Birmingham*, Cryogenic Engineering Lab, National Bureau of Standards, Boulder, Colo. (ASLE Paper No. 60—LC-4)

The Performance of Ball Bearings in Nitrogen and Carbon Dioxide at Elevated Temperatures, by *K. G. Eickhoff* and *A. White*, U. K. Atomic Energy Authority, Chester, England. (ASLE Paper No. 60—LC-5)

The Behavior of Lubricating Oils in Inert Gas Atmospheres, by *A. Beerbower* and *D. G. Greene*, Esso Res. and Engineering Co., Linden, N. J. (ASLE Paper No. 60—LC-6)

Session 3-B 9:00 a.m.

Fluid Film Journal Bearings

Chairman: *D. F. Hays*, Gen. Motors Technical Center, Detroit, Mich.

Vice-Chairman: *J. M. Gruber*, Waukesha Bearing Co., Waukesha, Wis.

Solution of Reynolds Equation for Arbitrarily Loaded Journal Bearings, by *O. Pinkus*, Gen. Elec. Co., Lynn, Mass. (ASME Paper No. 60—Lub-3)

Orthogonally Displaced Bearings, Part 1, by *D. F. Wilcock*, Gen. Elec. Co., Pittsfield, Mass. (ASLE Paper No. 60—LC-7)

Grease Lubrication Studies With Plain Journal Bearings, by *L. J. Bradford, E. M. Barber*, and *J. R. Muenger*, Texaco Res. Center, Beacon, N. Y. (ASME Paper No. 60—Lub-5)

Session 4-A 2:00 p.m.

Friction and Wear

Chairman: *W. E. Campbell*, consulting chemist, Cleveland, Ohio

Vice-Chairman: *M. E. Merchant*, The Cincinnati Milling Machine Co., Cincinnati, Ohio

The Effect of Lubricant Viscosity and Composition on Engine Friction and Bearing Wear, by *E. H. Okrent*, Esso Res. and Engineering Co., Linden, N. J. (ASLE Paper No. 60—LC-8)

Friction and Wear of Metals in Gases up to 600 C, by *D. F. Cornelius* and *W. H. Roberts*, U. K. Atomic Energy Authority, Chester, England. (ASLE Paper No. 60—LC-9)

Metallic Contact and Friction Between Sliding Surfaces, by *M. J. Furey*, Esso Res. and Engineering Co., Linden, N. J. (ASLE Paper No. 60—LC-10)

Development of Iron-Base Seal Materials for High-Temperature Applications, by *R. J. Mac Donald*, Clevite Corp., Cleveland, Ohio. (ASLE Paper No. 60—LC-11)

Session 4-B 2:00 p.m.

Fluid Film Thrust Bearings

Chairman: *O. Pinkus*, Gen. Elec. Co., Lynn, Mass.

Vice-Chairman: *A. A. Raimondi*, Westinghouse Res. Labs, Pittsburgh, Pa.

The Effect of the Method of Compensation on Hydrostatic Bearing Stiffness, by *S. B. Malanoski* and *A. M. Loeb*, The Franklin Inst., Philadelphia, Pa. (ASME Paper No. 60—Lub-12)

Performance of Elastic, Centrally Pivoted, Sector Thrust Bearing Pads, Part 1, by *B. Sternlight* and *E. B. Arwas*, Gen. Elec. Co., Schenectady, N. Y., and *J. C. Reid, Jr.*, Bureau of Ships, Washington, D. C. (ASME Paper No. 60—Lub-10)

Transient Lubrication of an Accelerated Infinite Slider Bearing, by *F. A. Lyman* and *E. A. Saibel*, Rensselaer Polytech. Inst., Troy, N. Y. (ASLE Paper No. 60—LC-12)

▶WEDNESDAY, OCTOBER 19

Session 5 9:00 a.m.

Hydrodynamic Gas Bearings

Chairman: *W. A. Gross*, IBM Research Lab., San Jose, Calif.

Vice-Chairman: *A. M. Loeb*, The Franklin Inst., Philadelphia, Pa.

An Improved Analytical Solution for Self-Acting Gas-Lubricated Journal Bearings of Finite Length, by *J. S. Ausman*, Autonetics, Inc. Downey, Calif. (ASME Paper No. 60—Lub-9)

An Assessment of the Value of Theory in Predicting Gas-Bearing Performance, by *S. Cooper*, Rolls-Royce, Ltd., Derby, England. (ASME Paper No. 60—Lub-9)

A Novel Form of Self-Acting Gas-Lubricated Thrust Bearing, by *A. Nahavandi* and *F. Osterle*, Carnegie Inst. of Tech., Pittsburgh, Pa. (ASLE Paper No. 60—LC-13)

Considerations on the Staring of Gas-Lubricated Bearings, by *M. Wildman*, Autonetics, Inc., Downey, Calif. (ASME Paper No. 60—Lub-11)

A Numerical Solution for the Gas Lubricated Full Journal Bearing, by *A. A. Raimondi*, Westinghouse Res. Labs, Pittsburgh, Pa. (ASLE Paper No. 60—LC-14)

ASME COMING EVENTS

September 7-9

ASME, AIChE, AIEE, IRE, ISA Joint Automatic Control Conference, Massachusetts Institute of Technology, Cambridge, Mass.

September 15-16

ASME-AIEE Engineering Management Conference, Morrison Hotel, Chicago, Ill.

September 18-21

ASME Petroleum Mechanical Engineering Conference, Jung Hotel, New Orleans, La.

September 21-23

ASME-AIEE Power Conference, Bellevue-Stratford Hotel, Philadelphia, Pa.

October 9-12

ASME Rubber and Plastic Conference, Lawrence Hotel, Erie, Pa.

October 17-19

ASME-ASLE Lubrication Conference, Statler Hilton Hotel, Boston, Mass.

October 24-25

ASME-AIME Fuels Conference, Daniel Boone Hotel, Charleston, W. Va.

November 27-December 2

ASME Winter-Annual Meeting, Statler Hilton Hotel, New York, N. Y.

March 5-9, 1961

ASME Gas Turbine Power Conference and Exhibit, Shoreham Hotel, Washington, D. C.

March 12-16, 1961

ASME Aviation Conference, Statler Hilton Hotel, Los Angeles, Calif.

March 16-17, 1961

ASME Textile Engineering Conference, Clemson College, Clemson, S. C.

April 6-7, 1961

ASME-SAM Management Engineering Conference, Statler Hilton Hotel, New York, N. Y.

April 9-13, 1961

ASME Oil and Gas Power Conference and Exhibit, Jung Hotel, New Orleans, La.

April 10-11, 1961

ASME Maintenance and Plant Engineering Conference, Bancroft Hotel, Worcester, Mass.

April 23-26, 1961

ASME Metals Engineering Conference, Penn-Sheraton Hotel, Pittsburgh, Pa.

May 7-10, 1961

ASME-EIC Hydraulic Conference, Queen Elizabeth Hotel, Montreal, Que., Canada

May 10-12, 1961

ASME Production Engineering Conference, Royal York Hotel, Toronto, Ont., Canada

May 22-25, 1961

ASME Design Engineering Conference and Exhibit, Cobo Hall, Detroit, Mich.

June 11-15, 1961

ASME Summer-Annual Meeting, Statler Hilton Hotel, Los Angeles, Calif.

June 14-16, 1961

ASME Applied Mechanics Conference, Illinois Institute of Technology, Chicago, Ill.

September 14-15, 1961

ASME-AIEE Engineering Management Conference, Hotel Roosevelt, New York, N. Y.

September 24-27, 1961

ASME Petroleum Mechanical Engineering Conference, Muehlebach Hotel, Kansas City, Mo.

October 4-6, 1961

ASME Process Industries Conference, Shamrock Hilton Hotel, Houston, Texas

October 17-19, 1961

ASME-ASLE Lubrication Conference, Morrison Hotel, Chicago, Ill.

November 26-December 1, 1961

ASME Winter-Annual Meeting, Statler Hilton Hotel, New York, N. Y.

(*For Meetings of Other Societies see page 108.*)

Note: Persons wishing to prepare a paper for presentation at ASME National meetings or Division conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Price to nonmembers, 50 cents; to ASME members, free.

Conducted for the National Junior Committee

J. W. FOLLANSBEE[1]

JUNIOR FORUM

Mechanical Engineers in the Building Industry

By J. W. Follansbee

"WELL, we have to redesign this section. They changed their minds again."

"We'll never meet deadline at this rate."

"That's our worry, not theirs."

These are engineers in the building industry talking. The conversation illustrates two parts of their job—the press of time and customer changes. These two plus design, economics, and co-ordination make up these engineers' jobs. Work for them is often hectic. But it probably is not any more hectic than for mechanical engineers in production, product design, or application. It's just hectic in different ways.

Mechanical engineers in this industry have one major purpose: To provide the mechanical services for a structure. Be it office building, plant, or research lab, a structure must be supplied with a reliable flow of gases and liquids to function properly. To do this you do not usually design equipment. Instead, you work on systems. Someone else designs the pumps, coils, fans, and furnaces; you put them together to create workable air conditioning, heating, ventilating, and water systems.

Many factors determine the final shape of a structure. Usually the customer and design engineers discuss what the customer needs and what is needed in the building to service those needs. It is during these talks you hit the real meat of the job. Here you do the fundamental design.

First you get the building's purpose. This tells you how much office space, production, and test area will exist. Each of these functions may require separate and different types of servicing equipment. Next, you will probably work out a fairly detailed theoretical analysis of each situation. From this you can figure how many systems you'll need and how big the equipment will be.

[1] Designer, Voorhees, Walker, Smith, Smith & Haines, New York, N. Y. Assoc. Mem. ASME.

Now you reach the economics. You cannot really tell total cost until you have added purchase, running, and estimated maintenance costs together. Knowing the loading, fuels costs in the area, money available for capital investment and running charges, and other data pertinent to a given job, you can work up the best over-all arrangement and location for the equipment room and feeder systems.

To get this best arrangement, a knowledge of mechanical engineering is not enough. You actually must work out several problems at once during the preliminary design. These include architectural aesthetics, psychrometrics, equipment rooms, system controls, electrical equipment; all relative to the building's function, the equipment's needs, and location.

After typing down the design, you will draw up a preliminary specification list. This will tell the customer, in general, what types and sizes of equipment he will get, but will not go into details. And, at this point you can start the working drawings.

You now know the equipment room location, and the location and function of all rooms this room serves. So you're ready to go into details. Precisely what fans, filters, coils, casings, motors, starters, pumps, and piping will go into this room, and where? Also, how will you service the other rooms? What is the size and distribution of the ducts, grills, diffusers, convectors, hoods, exhaust fans, and others that serve the building? These questions are answered while working out the working drawings. You found the general answers while going through the fundamental design. Now you can get the answers in detail.

When you've finished both fundamental and working drawings, the job goes out for bid, is let, and a contractor takes over. This article started by indicating mechanical engineers in this industry do design work. This is true. But they also work in the contractural stage. Here they transform the designers' engineering drawings into detailed erection and fabrication prints, without which the equipment cannot be installed. A mechanical engineer with a contractor estimates costs, purchases equipment, schedules deliver of equipment to the site, and co-ordinates the various trades needed to install the job. There are also contractors who do some or all of their own design work.

Let us suppose you come into this picture with little or no experience backing your degree. Where do you start? Any of several places: Estimating, design, drafting. It makes little difference, since eventually you will learn all these functions.

After a while, you get away from close supervision and start doing original design work. This generally includes layout work, but sometimes not. The first step on your own might be equipment room or ductwork planning. Or it could be figuring heat gains. Again, you will meet all these during your work. Eventually you will learn all the elements—heating, cooling, ventilating, equipment, and controls from both a design and economic viewpoint. The knowledge you pick up outside the ME degree comes pretty well in an automatic way, through necessity. And, as you go up, you will tend to remain a general practitioner rather than become a specialist. This will probably mean you will have a thorough knowledge of a few areas and a general knowledge of many.

A mechanical engineer can work for many types of firms in this field. The designer usually works in a consulting-engineering office, although some architectural firms have their own engineering staffs. Also, some manufacturing firms not in the building industry have need for full-time air-conditioning and heating engineers. The role of the contractor already has been mentioned. And another outlet is the firm that creates the equipment the consultant assembles into his systems. These last-mentioned firms tend toward specialization. How much depends on your job—designer, salesman application

If you would like to try engineering on your own, this industry is a good place to start. It is highly competitive, but has good rewards and chances of going out on your own as consultant are also good. This, and the broad nature of the work, are perhaps the two main points of difference between mechanical-engineering work in this field and the manufacturing areas. Otherwise, mechanical engineers here weep and groan about as much as those elsewhere. Yet most of them stay, once they arrive.

Report on Russian Automation to Highlight Joint Automatic Control Conference

A TEAM OF specialists, recently returned from the Soviet Union, will report on Russian achievements in automation, at the Joint Automatic Control Conference to be held September 7–9, at Cambridge, Mass.

The group, which returned from Moscow on July 2, will present "an analysis of the present status and future trends" of Soviet automatic control theory, scientific and industrial applications, and control system components. Chairman of the event, which will be held on September 8, at the Massachusetts Institute of Technology, will be Harold Chestnut, first president of the International Federation of Automatic Control.

The three-day meeting, to begin September 7, will be sponsored by The American Society of Mechanical Engineers in co-operation with the Institute of Radio Engineers, American Institute of Electrical Engineers, Instrument Society of America, and American Institute of Chemical Engineers. More than 500 are expected to attend. (For program see MECHANICAL ENGINEERING, July, 1960, pp. 106–107.)

Members of the symposium group, and their topics are: J. G. Truxal, head, Electrical Engineering Department, Polytechnic Institute of Brooklyn, Brooklyn, N. Y., "Developments in Automatic Control Theory"; N. B. Nichols, Mem. ASME, vice-president and chief engineer, Taylor Instrument Companies, Rochester, N. Y., "Developments in Control System Applications"; J. O. Hougen, Research Department, Monsanto Chemical Company, St. Louis, Mo., "Developments in Automatic Control Components"; Prof. Rufus Oldenburger, Mem. ASME, School of Mechanical Engineering, Purdue University, Lafayette, Ind., "Education and Automatic Control in USSR"; J. C. Lozier, Bell Telephone Laboratories, Whippany, N. J., "Over-All Impressions."

In addition to the symposium, 60 papers will be presented covering new techniques in control-system theory, testing of automatic units, newly developed components for possible use in automatic factories, and automation of chemical plants.

According to committee chairman W. E. Vannah, editor of *Control Engineering*, "Automation is an idea that touches us all in many little ways—now. Because it will profoundly alter manufacturing processes and business methods to come, it is bound to touch us to the quick—tomorrow. If we can understand the directions of current research in automatic control, we can get a pretty clear image of just how tomorrow's business and manufacturing will be conducted. From this image, we can anticipate the effects on us." The conference has been planned with this viewpoint in mind, and he said it would be advantageous for all engineers to attend.

Woman's Auxiliary to the ASME Awards Aid Engineering Students

Rothermel Scholarship. Andrew Mason Jackson, a graduate student at Virginia Polytechnic Institute, Blacksburg, Va., received the Marjorie Roy Rothermel Memorial Scholarship, a $750 award granted by the Woman's Auxiliary to The American Society of Mechanical Engineers.

Mr. Jackson's home town is Buffalo, W. Va. After he was graduated from high school in Charleston, he entered Virginia Polytechnic Institute as a Co-operative Mechanical Engineering Student. He was graduated in June of this year at the age of 22. While this young man has earned his expenses through high school and college by working, he has also found time for numerous extra-curricular activities. He became an Eagle Scout and Senior Patrol Leader, Boy Scouts of America; president of the Co-operative Engineering Society; executive officer of Pi Tau Chi; a member of the National Honor Society; Wesley Foundation; Honor Court; German Club; Pi Tau Sigma; Cadet Corps; The American Society of Mechanical Engineers; and the American Rocket Society.

Mr. Jackson plans to work toward a Master of Science Degree in Mechanical Engineering at Virginia Polytechnic Institute.

The Marjorie Roy Rothermel Memorial Scholarship is one of four Educational Funds maintained and administered by the Woman's Auxiliary to the ASME. It is a $750 scholarship awarded annually to a graduate in mechanical engineering for use in study toward an advanced degree in engineering. It was named in memory of Mrs. Rothermel, a past-president of the Auxiliary.

Committee Members are: Mmes. F. H. Fowler, E. R. Kaiser, Allen Latham, and D. V. Minard. For information concerning this Fund please write to: Mrs. Frank W. Miller, Chairman, 7805 Cobden Road, Philadelphia 18, Pa.

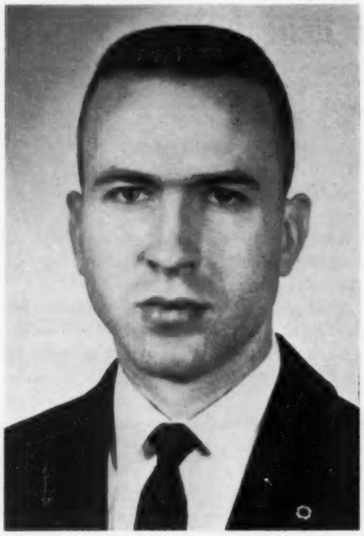
Sylvia W. Farny Scholarship Fund. Two Sylvia W. Farny Scholarships of $500 each were awarded this year. One went to William Baskin Walkup, an unmarried 20-year old student at the University of South Carolina. Mr. Walkup works for the South Carolina State Highway Department in the summer; has a paper route in the mornings; and is a student assistant in the Mechanical Engineering Department of the University. By attending Summer School, he was able to complete his first two years in one. His average is B-plus.

The other Scholarship went to Kenneth G. Harstad, attending the University of North Dakota. He is 21 years old and single. His average is 2.78 per cent out of a possible 3.00. He earns his tuition by summer jobs and maintenance work at the University and receives no support from his parents.

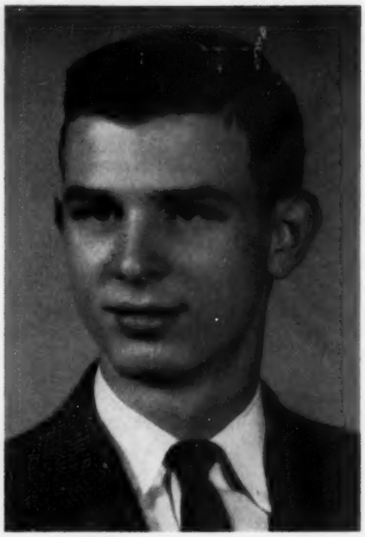
Committee Members are: Mmes. R. W. Worley, W. H. Larkin, Crosby Field, C. H. Kent, and George S. Gethen, Chairman.

Calvin W. Rice Memorial Scholarship Fund. The Calvin W. Rice Memorial Scholarship for 1960–1961 was awarded to Benami Grobman of Lima, Peru. Mr. Grobman is a graduate in mechanical and electrical engineering from the National University of Engineering in Lima. He is 24 years of age and single.

He wishes to pursue studies in the general field of heat and power, machine design, and economic analysis. He has had articles on solar energy published in professional journals, and is especially interested in hydroelectric plants in Peru.



Andrew M. Jackson



William B. Walkup

Kenneth G. Harstad

The Institute of International Education has secured a tuition scholarship for him at the University of Illinois and a United States transportation grant to and from this country. He will attend a four week's Orientation Course at the University of Texas, in August, and will report at the University of Illinois in September.

The scholarship award of $1500 is given to a foreign graduate student in mechanical engineering for one academic year's maintenance while taking graduate work in engineering in the United States.

Applications of students from several countries are sent to the Scholarship Committee by the Institute of International Education in New York. The Committee's choice for the award is recommended to the National Board of the Auxiliary for their approval.

Committee members are: Mmes. W. H. Byrne, W. E. Karg, J. W. Wilkenfeldt, C. H. Young, and A. R. Cullimore, Chairman.

Student Loan Fund. The Student Loan Fund continues to represent an active part of the work of the Woman's Auxiliary to The American Society of Mechanical Engineers.

Established in 1924, this Fund remained more or less dormant for several years. Then number of loans granted annually slowly mounted until it reached nine in 1957. But in 1958, the number jumped to 40, representing grants of $17,725. In 1959, 33 loans were granted, aggregating $13,795. In the first seven months of 1960, 22 loans totaling $9850 already have been granted.

Altogether, there are currently 57 loans outstanding, representing original grants of $24,725. The students receiving this financial help are in 29 different engineering institutions widely scattered throughout the United States. It is reassuring to note that there has never yet been a default in repayment, thus indicating the sound character of the future engineers for whom this Fund is administered.

Serving on the Student Loan Fund Committee are: Mmes. C. Bertelsen, H. R. Kessler, E. J. Sharkey, Jr., J. C. Somers, D. J. McDonald, Jr., Assistant Treasurer, and Walter F. Friend, Chairman.

Woman's Auxiliary Adds New Section. The Central Michigan Section was formed in October, 1959, to become the 28th Section of the Woman's Auxiliary to the ASME.

Certificate of organization was officially presented to the newest Section at a luncheon meeting held at the Country Club of Jackson, Mich., in March, 1960. More than 200 wives of mechanical and electrical engineers attended this luncheon. Special guests at this luncheon were Mrs. T. N. Graser, Needham, Mass., National Auxiliary President; Mrs. Walker L. Cisler, Detroit, Mich., wife of the National President of ASME; Mrs. J. Harold Foote, Jackson, Mich., wife of the National President of AIEE; and Mrs. Clarence C. Franck, Sr., Swarthmore, Pa., Sponsor of the Section.

At the end of a successful and exciting first year, the Central Michigan Section was able to contribute $50 to the Student Loan Fund.

Mrs. J. C. Beres is Chairman of the Section, whose Membership totals 41, and it promises to be an active Section.

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

The application of each of the candidates listed below is to be voted on after Sept. 23, 1960, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and Transfers

Alabama

•Bradley, Glenn F., Sheffield

Arkansas

Lipe, Ray W., Pine Bluff

California

•Bailey, John A., San Jose
Berenson, Paul J., Santa Monica
Clithero, Donald L., San Mateo
Fiedler, W. Robert, Riverside
•Huang, Francis F., San Jose
Huber, Milton W., Torrance
•Klute, Daniel O., Granada Hills
Puzin, LeRoy T., Anaheim
•Rosenberg, Richard, Palo Alto
Smith, Harold J., Concord
•Tippin, Billy B., Pleasant Hill

•Transfer to Member or Affiliate.

Zaremba, Wieslaw A., San Francisco

Colorado

Victor, Michael L., Denver

Connecticut

Geitz, Robert C., Darien

Florida

•Gothard, Edwin S., Pensacola

Idaho

•Clayton, Ned J., Idaho Falls
Davidson, Carlisle, Jr., Idaho Falls

Illinois

Callanen, Frederick B., Chicago
•Mock, Clifford I., Chicago
Wolff, Ernst, Bloomington

Indiana

Pera, Norman J., Indiana Harbor
Young, John W., 3rd, Indianapolis

Iowa

Foster, Jewett E., Marion
Schmidt, Donald F., Cedar Rapids

Louisiana

•Daniel, Lawrence R., Jr., Ruston
•Levine, David J., New Orleans
Lindsey, Lawrence V., New Orleans

Maryland

•Alvey, Courtney D., Baltimore
•Buckley, John J., Baltimore
Liebowitz, Harold, Chevy Chase
Renda, John D., Baltimore

Massachusetts

Fortini, Earlwood T., Wellesley Hills
Phipard, Harvey F., New Bedford
Seibold, Paul F., Worcester
Sharp, Arnold G., Woods Hole
Streich, Walter W., Nahant

Michigan

Fahrner, William J., East Detroit
Goldberg, Gerald L., Detroit
Olsen, Ralph A., Grosse Pointe Woods

Missouri

McBride, Donald W., Kansas City

Nevada

•Mangin, Joseph L., Las Vegas

New Jersey

•Hashizume, Toshio T., Morris Plains
•Ross, Melvin, New Milford
Taylor, Ralph, Newark
Wright, Paul E., Haddonfield

New York

Chiang, Chao-Wang, Corning
Cochran, Paul L., Schenectady
Derr, Donald B., Poughkeepsie
Flannery, John W., New York
Lohse, Erich, White Plains
Macek, Joseph S., Utica
Pearson, Samuel H., Schenectady
Peters, Harry L., Hyde Park
•Smith, Charles Z., Delmar
Wichert, Karl E., Bay Shore

Ohio

•Bayless, Frank K., Cleveland
Brown, Alec T., Cincinnati
Callahan, Francis J., Chagrin Falls
Chatterjee, Anil K., Akron
Csaky, Thaddeus G., Dayton
•Ferrari, Anthony S., Toledo
Hobek, Robert G., Cincinnati
•Lang, Alfred B., Cincinnati
•Siegel, Robert, Cleveland
•Swallow, Robert J., Lakewood

Oregon

•Funatake, Tai, Portland

Pennsylvania

•DePaoli, Henry, Emmaus
Ebert, Robert J., Johnstown
Freund, John W., Pittsburgh
Gardiner, Frank J., Bryn Mawr
Martin, John W., Drexel Hill
•Master, Gerald L., Reading
Moore, Desmond F., Chester
•Rees, Donald R., Reading
•Smith, William A., Jr., Hellertown
Stuart, William M., Allentown
Wood, Bruce, Riegelsville

Rhode Island

•Duffy, Jacques W., Providence
Waterman, John E., Chepachet

South Carolina

Wallace, Clinton R., Hartsville

South Dakota

•Christianson, Kenneth D., Brookings

Tennessee

•Gayle, Tom M., Oak Ridge

Texas

•Gass, Robert H., Amarillo
Morris, Ghenie W., Greggton

Vermont

Wadhams, Jess H., Springfield

Virginia

Robbins, Walter A., Danville
Scruggs, William D., Richmond

Washington

•Gershun, Theodore L., Seattle
Speidel, Robert W., Kennewick

West Virginia

Woodford, Herman F., New Martinsville

Foreign

•Clarke, John M., Islington, Ont., Canada
•Desmond, John J., Palembang, Sumatra, Indonesia
Hu, Er-Kong, Taipei, Republic of China
Johnson, John G., North Vancouver, B. C., Canada
Joshi, Azhikath-Ninan, Madras, South India
Kelgard, Erik, Kamloops, B. C., Canada
Lin, Chin N., Keelung, Taiwan, China
Martin, Andre C., Liege, Belgium
Mehrotra, Rajendra, Gwalior, M. P., India
Perez, Nestor E., Caracas, Venezuela
Peters, Murray P., Downsview, Ont., Canada
Ramachandran, Sankaranarayanan, Bihar, India
Sanderson, Henry F., West Vancouver, B. C., Canada
Vyvial, Anthony J., Montreal P. Q., Canada
Wright, Leslie S., Tambaram, Chingleput, Madras
Wu, Hsi-Sheng, Taipei, Taiwan, China

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC [Agency]

These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which co-operates with the national societies of Civil, Electrical, Mechanical, and Mining, Metallurgical and Petroleum Engineers, is available to all engineers, members or nonmembers, and is run on a nonprofit basis.

If you are interested in any of these listings, and are not registered, you may apply by letter or résumé and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 60 per cent of the first month's salary if a nonmember, or 50 per cent if a member. Also, that you will agree to sign our placement-fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application to the employer and for returning when possible.

NEW YORK	CHICAGO	SAN FRANCISCO
8 West 40 St.	29 East Madison St.	57 Post St.

Men Available[1]

Chicago Office

Safety Engineer, BSME; 39; 12 years' experience in casualty field, six as supervisor of branch office with responsibility for training safety engineers, developing safety programs, administering department work. Handled large risks. Licensed for elevator inspection in several states. $7200. Midwest. Me-1138-Chicago.

Design Engineer, BS Metallurgical Engineering; 30; 5 years' experience in design, development, and testing of heavy construction equipment. $7800. Southeast, South, Southwest. Me-1139-Chicago.

Service **Manager, Sales Engineer, Project Manager,** BSME; 33; assistant to senior project engineer, liaison-type of engineering work; product, analog computers, and inertial guidance. Supervised testing of experimental equipment. Secret clearance. $10,000. La., Ariz., or Fla. Me-1140-Chicago.

Project Engineer, BS (ME); 31; five years' experience as project engineer, three of which were supervising all phases of test work connected with future high-compression ratio engines and their fuel requirement. $8000, minimum. Midwest. Me-1141-Chicago.

New York Office

Personal Assistant to Manufacturing Executive or Industrial Management; BME, 1948; MME, 1953; 12 years' broad industrial and administrative experience as methods analysis engineer, production engineer, works manager. To start, $8500. No preference location. Me-850.

[1] All men listed hold some form of ASME membership.

Technical Liaison or Administration, BS and BSME; 33; nine years' general engineering experience in heavy industry. Mechanical design, estimating, and construction. Good writer, speaker, organizer. $7000. Prefers Midwest. Me-851.

Senior Plant Engineer, BS Ind. Engr., diversified experience in alloy and chemical plants. Supervise draftsmen and engineers in project design and plant expansion for multiplant operations. Experience includes co-ordination of cost estimates, design, specifications, purchasing, and installation of new plants and equipment. $9300. South. Me-852.

Plant or Project Manager, BME; 20 years' continuity of experience in process industries, with ten years direct supervision of engineering design, plant construction, process installations, equipment purchasing, maintenance, process improvements in large-scale processing plant serving a segment of food industries. $15,000. Prefers Pa. or East. Me-853.

Power-Plant Engineer, BS Mechanical, BS Marine and Electrical; seven years operating, five steam, and two diesel. Two years power-plant construction and start-up, experienced in water treatment. $7200–$7500. East. Me-854.

Executive Engineer, Eng. ScD (Mechanical); MS (Chemical); more than ten years research, development, application of lubricants, covering wide experience manufacturing and process industries. Responsible for top-level projects involving lab-customer relations. $15,000. Prefers Metropolitan N. Y. Me-856.

Mechanical Engineer, PE, experienced in installation of mechanical equipment of buildings and medium-sized power plants, at responsible

levels, including plumbing, mechanical, and sprinkler systems. Seeks connection with contractors or professional engineer. Me-857.

Chief Engineer, BS, MS; PE; 14 years' experience mostly in field of heavy machinery design. Strong analytically with considerable design, field, and supervisory experience. $15,000. Location immaterial. Me-858.

Senior Engineer, Mechanical, BME Pratt Institute; ten years' experience, majority in design of electromechanical components; balance in engineering administration. $11,000, plus. L. I., New York City, and vicinity. Me-859.

Mechanical Engineer, ME; 55; 35 years in design and development of electromechanical instrumentation. U. S. Navy gun-fire control and navigating equipment. Supervising 250 designers and draftsmen in this work. Past five years with electronics firm, in design and development computer components. $10,000. New York City or N. J. Me-860.

Project or Supervisory Engineer, BME; nine years' experience in design and production in refinery, detergents and toiletries, and film and sheet processing. East (metropolitan area). Me-861.

Supervisory Engineer, ME; experienced in electromechanical equipment and military electronics. $13,000. Metropolitan N. J. Me-862.

Engineering Trained Businessman, young executive, graduate studies in both mechanical and civil engineering; general manager of a small shipyard for four years; handled all aspects of business as assistant to president-owner while taking charge of operations. Seeks position as assistant to chief operating executive in any type manufacturing operations. Me-863.

Manufacturing Executive; ability to get things done, mindful of cost and profit, by the use of intuition and scientific management tools plus the ability to communicate pleasantly to people at all levels. Scientific and business background; PE. $16,000, plus incentive. Me-864.

Product-Development Engineer, BSME; manager, air conditioning R&D, two years. Central residential air-conditioner development, design, and specification. $9600. Eastern U. S. Me-865.

San Francisco Office

Plant Staff Engineer, Food Processing, ME, 37. Design and layout new buildings, packaging lines, process equipment, material handling. Supervise maintenance, board work, construction. Veteran-Navy Officer. $11,500. Any location. Home: N. Y. Se-1341.

Senior Design, R&D, BSME, BSAE, 38. Eight years' experience in rocket, aircraft industry, including design, R&D, and test. Four years' experience R&D on automotive equipment. Salary open. Prefers Calif., Midwest. Home: Mich. Se-1574.

Plant Engineer, StructlE (Germany), 49; 20 years' experience in manufacturing at higher levels in management, sales, import-export to European countries; development, research, design. $12,000. Prefers San Francisco Bay area, Northern Calif. Home: Calif. Se-1474.

Sales Engineer, BSME; 36; experience promotion, sales, and application of heating and air-conditioning products through architects, engineers, heating, and air-conditioning contractors, industries, institutions, and wholesalers for a broad range of application in all types and sizes of buildings. $11,000. Prefers San Francisco area. Home: Ill. Se-1472.

Partner or Associate, ME; 43; 15 years' experience in building, design and construction, and lumber-yard operation. Licensed master plumber, experienced in housing and building finance, and sales promotion. Would like connection with contractor. Interested in investment construction. $12,000. Prefers San Francisco Bay area. Home: Calif. Se-1444.

Designer, ME; 34; 11 years' experience design, including aluminum plant, material-handling equipment, and paper-manufacturer machinery, mills layout, paper machinery components, estimate, and supervise. $7800. Prefers San Francisco Bay area. Home: San Francisco East Bay. Se-1431.

Production, Design, Maintenance, 33; nine years charge of manufacturing, production, tool design, machine shop, plant maintenance for business-machine manufacturer, sugar plant. Two years mechanical technician, tool design, quality, and product control for manufacturers. $5000. Prefers San Francisco Bay area. Home: San Francisco. Se-1421.

Production or Development Engineer, ME (England); 32; eight years' experience in machine design and development, production engineering in communications industry, plus five years' engineering apprenticeship. $9600. Prefers San Francisco Bay area. Home: Canada. Se-1419.

Tool Design, Detail, Mechanical, Tool Engineering (Budapest), 33; ten years' experience layout, detail, design, redesign of earthmoving equipment, hydraulic pumps, jigs, fixtures, special tools, electronic components for microchem lab, missile products. $7800. Prefers San Francisco Bay area. Home: San Francisco. Se-1886.

Additional listings of positions and men available are maintained in the offices of E.S.P.S. Direct inquiries to nearest office. A weekly bulletin of engineering positions open is available at a subscription rate of $4.50 per quarter or $14 per annum, payable in advance.

Sales Engineer, 45; 25 years' experience, progressed from mechanical drafting through production quality control to direct customer sales, charge of co-ordinating products and direct sales to automobile manufacturers. $10,200. Prefers San Francisco Bay area. Home: East. Se-1171.

Plant Superintendent, Industrial Engineer, ME; 47; five years supervision of construction, design, operation of foundry. Fifteen years industrial engineer for ferrous and nonferrous foundry. Six months research, maintenance on furnaces. Salary open. Any location. Home: Pa. Se-1120.

Power-Plant Design, MSME; 48; steam-power plant designer, 14 years' experience provides good practical background and 13 years university teaching gives good theoretical background. Salary open. Prefers San Francisco or Central Calif. Se-1088.

Safety, Field Engineer, ME; 41; seven years' experience fire prevention, periodic loss-prevention inspections, special studies of industrial fire problems, prepare loss reports. Review and inspection of fire-protective equipment. $9000–$12,000. Any location. Home: Ohio. Se-556.

Plant Engineer, Maintenance, ME; 35; seven years' experience superintendent of maintenance, organization, directing, scheduling, recommending purchase of material, budgets, cost control for industrial chemicals company. $12,000. Prefers San Francisco Bay area, Northern Calif. Home: Calif. Se-979.

Instructor, MinE, Met, 59, Regis ME (Penn) with 34 years' experience in calculation and laboratory verification of complex structure stresses using most modern techniques. Desires instructorship in strength of materials lab in engineering school with consulting privilege. $10,000. Prefers Pacific Coast. Home: Mo. Se-980.

Positions Available

Chicago Office

Chief Process Engineer, mechanical or industrial graduate, 35–50. Will be responsible for product, process, and plant analysis to achieve most efficient operation on continuing basis. Must have solid background of machining-process experience in plants current in tooling and cutting practice. Good opportunity. $8000–$9500. Ohio. C-8222.

Project Design Engineer, graduate mechanical. At project-engineering level to design light structures, pressure and fluid container devices, etc. Must have knowledge and ability to apply in design calculations the following: Mechanics, both static and dynamics, particularly in properties and strength of materials; stress analysis, mechanism analysis, and design, heat transfer and fluid flow; knowledge of relationships and calculations necessary to determine sizing, shape, and relationship of components of heat-transfer, or fluid-flow transport system. Experience in fabricating techniques including design of light and medium-gage ferrous metal forming, casting and machining, nonferrous and plastic fabricating methods, engineering economics to make detailed cost estimates of designs for a manufacturer of water heaters. Open. Employer will pay placement fee. Ill. C-8218(a).

Product Design and Development Engineer, graduate mechanical, to 40, at least three years' experience in original design and layout of heavy equipment, to design and develop railroad equipment. About 50 per cent of time on the board. Must be U. S. citizen. $10,000. Employer will pay placement fee. Chicago, Ill. C-2808.

Project Engineer, BSME, 30–35. Will report to chief engineer at project level to develop new vibratory soil compactors, both towed and self-propelled units. Should be able to take basic information on a project and make initial layouts and preliminary drawings. Practical experience in design and fabrication of steel and plate members necessary. Should be able to write specifications calling for the bending of plate and also welding. Must be able to run preliminary stress analyses on fabricated plates and beams. Experience in proper selection of proper V-belt drives, bearing, and gear trains necessary. $9000–$12,000. N. J. C-8207.

Pump Designer, graduate mechanical, to 40, at least five years' experience designing on the board in suction and centrifugal pumps up to 300 hp. Work is all designing on the board and then turning over to draftsmen for final details. Must be content to work on the board for about two years. To $8400, depending upon experience. Employer may negotiate the fee. Ohio. C-8157.

New York Office

Blast-Furnace Operator for an integrated steel plant. Will be in complete charge of operations. Must be capable of training native help in supervision and operation. Prefer a mature individual. Living quarters available but schooling is inadequate. At least a two-year contract. Apply by letter including complete résumé and salary requirements. Excellent climate. So. America. F-9419.

Development Engineer for R&D Section of manufacturer of centrifugal pumps and hydraulic dredges, experienced in the design of centrifugal, mixed flow, and axial flow pumps. Should be capable of the complete design of such equipment and to expand into the handling of abrasive and non-Newtonian fluids. Upstate N. Y. W-9418.

Project Engineer, young, graduate mechanical or chemical, two to three years' experience in chemical or pharmaceutical plant and estimating design; willing to do own drafting. About $8000. Northern N. J. W-9412.

Mechanical Engineer, graduate or equivalent experience with a flare for original thinking in developing new product designs using metal, plastic, and rubber, having intimate contact with product from inception to pilot production. Excellent opportunity. Northwestern Pa. W-9404.

Welding Engineer, graduate mechanical or metallurgical, five to eight years' experience in welding engineering, and at least two years in charge of a welding-engineering group performing welding-engineering R&D. Must have good working knowledge of major welding processes and a good foundation in ferrous metallurgy, in particular the welding and application of metals for high-temperature, high-pressure service. Should have technical writing skill and ability to speak effectively before moderately large groups. Must be capable of effectively supervising engineers and technicians performing both development work and shop-welding control. $10,000–$12,000. Company pays placement fee. Pa. W-9403.

Materials-Handling Engineer, graduate mechanical or equivalent, experience in design of belt conveyers, screening, grinding, crushing, and dust-collecting installations; specifically in run-of-mine ore in modern high-speed and large-tonnage applications. Should also be familiar with materials-handling equipment for pulp and paper, and iron and steel industries, having acted in a trouble-shooting, problem-solving capacity. $10,000–$13,000. Company pays placement fee. New York, N. Y. W-9402.

Engineers experienced in the iron and steel industry. (*a*) Furnace and heat engineer, graduate mechanical or metallurgical, intensive background in operation of steel mills, particularly in reference to furnace design, heating engineering, furnace operations, etc. $13,000–$15,000. (*b*) Rolling mill engineer, graduate mechanical or metallurgical, strong background in steel-mill operation. Experience must include extensive exposure to rolling mill design and equipment installation. $13,000–$15,000. Company pays placement fees. New York, N. Y. W-9399.

Project Engineer (Trainee), BS in mechanical or metallurgical engineering, none to two years' experience, basic knowledge of engineering principles, and ability to apply these principles to routine problems. One-year training program designed to provide familiarization and training in basic engineering principles of each of the division product lines. Will be assigned to one of four engineering groups, with advancement toward project or product engineer. To $6300. Training locations: Northern N. J.; Mo.; Chicago, Ill.; Ohio; or Ala. W-9380.

Mechanical Engineers. (*a*) Project engineers, staff engineering, graduates, two to five years' experience in design, engineering, and construction of complete manufacturing facilities; in plant and equipment design and layout of paper converting or other product finishing and packaging facilities. (*b*) Project engineers, mechanical R&D, BSME required and BSEE or MSME desirable, two to five years' experience, specifically in the development of automated rotating equipment for continuous production application. (*c*) Project engineers, plant engineering, mechanical graduate, up to five years' experience for work in manufacturing/production engineering activities for all phases of pulp, paper, converting,

and general plant facilities. Salaries open. (a, b) Pa.; (c) Maine, Mich., Pa., and Wisc. W-9369.

Engineers. (a) Plant engineer, graduate mechanical or chemical, minimum of five years' experience in maintenance or project engineering in chemical-process industry. Prefer some supervisory experience. Will supervise small maintenance crew and perform engineering-plant studies; administer small plant-maintenance programs. $9600–$13,200. (b) Production supervisor, graduate mechanical or chemical, minimum of five years' experience in process engineering or equivalent, some first or second-level production supervisory experience. Will be responsible for small plant-production operation; will supervise shift foremen and operating crew of 25–35 men. $8400–$12,000. South. W-9364.

Tool Designer, 35–50, for a firm specializing in stamping, fasteners, and assemblies. Must be thoroughly familiar with metalworking industry with particular emphasis stamping and drawing power presses of all types and possess a general engineering knowledge. Will do tool design including engineering of compound and progressive dies from models and/or part experimental proof to production machinery available. Must be able to detail, draft, and/or draw complete part drawings, assembly drawings, die drawings. Salary commensurate with experience. New York, N. Y. W-9362.

Superintendent, Mechanical and Electrical Maintenance Mining Division, graduate mechanical, five to ten years' supervisory experience maintaining heavy duty equipment used in open-pit mining operations such as production trucks, diesel and electric shovels, road graders, bulldozers, drills, etc.; knowledge of electrical maintenance in open-pit mine required. Will be responsible for co-ordination of all mechanical and electrical maintenance; responsible for electric-power generation and distribution for all mine operations and adjacent townsite. To start, $15,000. Working knowledge of Spanish required. So. America. F-9630.

Supervising Design Engineer, industrial hydraulic lifts, graduate mechanical, minimum of five years' experience in industrial hydraulic-lift design engineering or similar design-engineering experience. Experience should be on design of welded structures, unique mechanisms, oil hydraulics, and simple electric circuits. Must be capable of assuming supervisory responsibilities. To start, to $10,000. Midwest. W-9356.

Machine Designers who have had considerable experience over the board designing packaging equipment, or automation devices, or fairly complicated machines that would fall in the general category of medium-sized machines. Must have inventiveness, imagination, and initiative. $10,000–$12,000, plus unusual fringe benefits and profit-sharing plan. Va. W-9354.

Heat-Transfer Development Engineer, 27–35, preferably MS in mechanical or chemical engineering, but will consider BS with approximately five years' experience in analytical heat-transfer engineering, for development of improved heat-transfer surfaces for heating, refrigeration, air-conditioning, and process applications. Must have well-rounded background in the theory of heat transfer and fluid flow. To $10,800. Midwest. W-9344.

Project Manager, Pulp and Paper, graduate mechanical, broad background in various phases of engineering, design, and initial operation of plants in the pulp and paper fields. Experience must include erection and start-up of pulp and paper mills and involve areas such as new installations of equipment, operations of digestors, preparation plants, washing plants, instrumental equipment, and machinery for pulpmaking and paper-finishing equipment. Will be responsible for co-ordinating company's technical activities on customer-process engineering, design and construction contracts; oversee all technical aspects of sales inquiries, progress of projects, etc. $15,000–$18,000. Company pays placement fees and relocation expenses. New York, N. Y. W-9325.

Quality-Control Engineer, graduate mechanical, to test method-preparation procedures and specifications and sampling plans for electronic component manufacturer. About $10,000. New York, N. Y. W-9322.

Industrial Engineer, Metal Work, graduate industrial or mechanical, 25–30, minimum of two to three years' experience related to work methods, evaluation, establishing work standards, working up of wage-incentive plans. For metals-machining methods; for metals-machining shop (forge). Should be talented person with ability to relate these factors to cost reduction, work simplification, on-the-job training on supervisory basis. Excellent position with excellent company who have need for outstanding talent. $8000–$10,000. Pa. W-9315.

Industrial Facilities Sales Engineer, 35–45, ten years' experience with process facilities or with engineering company designing such facilities involving material handling and processing tanks, vats, conveyers; some metallurgical background desirable. $12,000–$14,000. New York, N. Y. W-9311.

San Francisco Office

Tool Designer, tooling background. Minimum two solid years as tool designer in machine shop, experience designing machine fixtures, drilling jigs, gages, etc. Primarily ferrous and in medium and light fields. Should be able to work with shop, tool room, and engineering drafting personnel. For manufacturer of industrial valves and pressure regulators. $6000–$7200. San Francisco East Bay. Sj-5445.

Instrumentation Design, EE, ME, or equivalent. At least five years' experience application and systems design of instrumentation for chemical, petrochemical, or petroleum plants. Should be able to provide complete design function with minimum supervision. Salary commensurate. Relocation allowance and employer will pay placement fee. For engineering builder. San Francisco. Sj-5440.

Designers, ChE, minimum five years' experience in design of refinery, petrochemical, or chemical plants. Able to relate all phases of this type of work from beginning to completion. Salary commensurate. Relocation allowance and employer will pay placement fee. For engineering builder. San Francisco. Sj-5439.

Designers, ME, minimum of five years' experience in design of refinery, petrochemical, or chemical plants or related. Able to relate all phases of this type of work from beginning to completion. Salary commensurate, relocation allowance and employer will pay placement fee. For engineering builder. San Francisco. Sj-5438.

Technical Director, Physicist, Electronic, ME (PhD preferred). Well qualified by recent and extensive experience (probably assist technical director or senior scientists engaged in electromechanical field); possibly operating in field of optics, infrared, radar, basic physics, with the objective of initiating and developing ideas. Must be capable of administering and directing department and engaging in applied research for advanced product development, which is used for gathering data, storage, detection for monitoring, or observation purposes. Should be familiar with electronic science and mechanical aspects. For new company. $15,000 up. San Francisco Bay area. Sj-5432.

Production Engineer, ME, background in machine-shop practice and exposed to production problems of schedule, quality control, union relation, tooling, and methods improvement, etc. $8400 start. Company will pay placement fee. For fabricators and manufacturers of metal products. San Francisco Peninsula. Sj-5430.

Equipment Designer, ME, three years' experience including designing, mechanical and chemical fields essential—sanitary also desirable, to design equipment for sea water demineralizing test stations. Prepare drawings and specifications, check design made by others and collaborate with research engineers. Supervise mechanical personnel and co-ordinate construction and maintenance work. Supervise engineering aids taking test data and operation of major experiment stations when tests are being run. $8520–$10,344. For institution. San Francisco East Bay. Sj-5426.

Sales Engineer, mechanical background, 24–38. Aptitude for, or experience in, sales engineering on products to o.e.m.'s in western states and ability to work with distributors. Will train if necessary. Experienced man should be able to read blueprints, perform elementary math calculations, have knowledge of design and strength of materials related to rotating machinery parts, and components. Los Angeles. For manufacturer's district office. Trainee, $4800; more for experienced man. Car furnished. Sj-5424-R.

Designer, machinery background. Minimum three years' recent experience related to hydraulic cylinder design, valving related thereto (as encountered in machine tool and other mechanical applications). Should be familiar with hydraulic equipment as applied to machine tools and other mechanical equipment; must be able to design, specify equipment, develop light circuit, and do drafting and detailing for application, engineering, and shop drawings, should be able to handle drafting and design of heavy machinery. For a manufacturer. $7200 up depending on experience. 150 miles north of San Francisco. SJ-5408.

Sales Engineer, ME background, 30 up, experience selling mechanical equipment (pneumatic and hydraulic actuators) to plant-engineering departments and designers. Some o.e.m. primarily to users for shop purposes. Established accounts for manufacturer's representative and distributor. $6300–$7500, depending on experience, plus car allowance and bonus. Car required. San Francisco headquarters. Territory assigned may be anywhere between Fresno and Ukiah. SJ-5407.

OBITUARIES

Merton H. Arms (1894–1960), vice-president, Bryant Chucking Grinder Co., Springfield, Vt., and managing director, Bryant Machinery Ltd., Rainham, Essex, England, died, Springfield, Vt., Jan. 12, 1960. Born, Burlington, Vt., April 15, 1894. Parents, Robert A. and Stella H. (Crane) Arms. Education, BS(Me), Univ. of Vermont, 1917. Married Marion Day, 1920; children, Arthur C., Margaret C., and Harriet M. Mr. Arms was a junior engineer with the Remington Typewriter Co., Syracuse, N. Y., from 1917 to 1918. He worked on the manufacture of gas masks in New York City for the U. S. Army Gas Defense Division, Chemical Warfare Service from 1918 to 1919. He joined Bryant Chucking Grinder Co. as a design engineer in 1919, specializing in machine-tool design. He became chief engineer, and then vice-president in 1956, at the same time rising to managing director of Bryant Machinery, Ltd. He was the author of several machine-tool patents. Mem. ASME, 1931. He served the Society as secretary-treasurer and chairman, Green Mountain Section, ASME. Member also of Vermont Society of Engineers.

Paul A. Baumeister (1889–1960), retired mechanical engineer, died, Flushing, N. Y., May 11, 1960. Born, College Point, N. Y., July 24, 1889. Parents, John and Louise C. Baumeister. Education, attended Columbia Univ., ME, 1912. Married Maude Riceman, 1924; children, Robert John and Louise Carol. Mr. Baumeister was a design engineer for Ingersoll-Rand Co., Phillipsburg, N. J., from 1912 to 1915, heading his department for a period. In 1915 he became a sales engineer for the company's New York office. From 1933 to 1937 he was a consulting engineer for Arthur A. Johnson Corp., Long Island City, L. I., N. Y.; and from 1937 to 1940 was an assistant warehouse manager with Chapman Valve Mfg. Co., Indian Orchard, Mass. He specialized in air and gas compression and thermodynamics. Assoc. Mem. ASME, 1918; Mem. ASME, 1935. He was a licensed and registered engineer in New York State.

Frank L. Bigelis (1909–1960), chief project engineer, American Sterilizer Co., died, Erie, Pa., April 20, 1960. Born, Patterson, N. J., Feb. 21, 1909. Parents, Charles and Agatha Bigelis. Education, EE Rensselaer Polytechnic Institute, 1930. Married Dorothy Ann Lindberg, 1933. Mr. Bigelis designed numerous pieces of industrial, food service, and medical equipment. From 1931 to 1941 he was an estimator and designer with S. Blickman Inc., Weehawken, N. J., where he designed equipment such as operating tables, electric food carts, whirlpool baths, and infant incubators. For three years thereafter he was a product designer and engineer for the American Sterilizer Co., Erie, Pa., where he developed designs for two obstetrical operating tables of the head-end control type. He also developed a field-type pressure sterilizer for the U. S. Army, and did considerable work on modification of U. S. Navy equipment designs to enable them to withstand 2000 ft-lb high-intensity shock. He was a project engineer 1943–1948 for the Ritter Co., Inc., Rochester, N. Y., manufacturers of dental office equipment. While there he designed a motorized doctor's table in which all conventional patient positions could be achieved through movement of clutches controlled by levers; and an all-purpose table for the osteopathic profession in which were combined the elements of a mechanical, a straight, and a general practice table. In 1948 he returned to the American Sterilizer Co., where he became chief product engineer, directing many projects. Mem. ASME, 1958. He was also a member of the Professional Society of Engineering and the Engineering Advisory Council of Gannon College, Erie, Pa. Surviving are his wife; two sons, Charles F. Bigelis, Cheswick, Pa., and Frank L. Bigelis, Jr.; one grandson, William Bigelis; his mother, Mrs. Agatha Bigelis, Rochester, N. Y.; two sisters, Mrs. John Cowen and Mrs. William Knechel, both of Rochester; and a brother, William Bigelis, Madison, N. Y.

George Edwin Crawley (1886–1960), consultant-member, board of directors, The Francisco Sugar Co., New York, N. Y., died, New York, N. Y., May 19, 1960. Born, Brooklyn, N. Y., March 19, 1886. Parents, Edwin Fitzroy and Anna Frances (Mooney) Crawley. Education, ME, Columbia Univ., 1908. Married Esper-

anza Rionda, 1921; children, George Edwin, Jr., Charles Albert, and Esperanza Rionda. Mr. Crawley joined the Francisco Sugar Co. as an engineering assistant in 1914. He became assistant to the general manager in 1917, and general manager in 1924. As general manager he directed the operation of the company's Cuban properties. Later he became vice-president and treasurer-director of the company. Assoc. Mem. ASME, 1908; Mem. ASME, 1928. He was a member of Tau Beta Pi.

William Millen Duncan (1872–1960), president, Illinois Stoker Co., died, Alton, Ill., April 11, 1960. Born, Alton, Ill., May 1, 1872. Parents, Gilbert and Sarah Jane (McNiel) Duncan. Education, graduate Alton High School. Married Mary Drummond (deceased). Mr. Duncan was engaged as an apprentice by the Duncan Foundry Co., where he was trained in chemistry, engineering, and foundry and machine-shop work. He had five years drafting-room experience gained while employed by the Illinois Stoker Co. and Duncan Foundry; and had 27 years machine-shop experience, five years with American Coal Washing Co., 20 with Duncan Foundry, and two with Illinois Stoker Co. He designed and patented coal washers, mining machinery, smokeless furnaces, and stokers for these three companies. At one time he held the following positions simultaneously: Secretary and treasurer, American Coal Washing Co.; general manager, Duncan Foundry Co.; and vice-president, Illinois Stoker Co. Mem. ASME, 1911.

John Gillett (1882–1960), retired partner, Bellman, Gillett and Richards, died, Toledo, Ohio, May 30, 1960. Born, Bay City, Mich., May 26, 1882. Parents, Hezekiah M. and Helen M. (LeConey) Gillett. Education, attended Univ. of Michigan. Married Mary M. Muckley, 1907. Mr. Gillett specialized in heating, ventilating, air conditioning, plumbing, and factory planning. He was a draftsman at the Kilby Mfg. Co., Cleveland, Ohio, designing beet-sugar factories and machinery, 1901–1906; and a draftsman and mechanical engineer for the New York Central Lines, Cleveland, where he layed out locomotive and car shops, power plants, roundhouses, and equipment, 1906–1913. He entered the architectural and engineering firm of Mills, Rhines, Bellman and Nordhoff, Toledo, Ohio, in 1913. He was the last surviving member of this firm. In 1944 the firm's name was changed to Bellman, Gillett and Richards. Mr. Gillett retired five years ago. He was identified with many Toledo buildings, including the Univ. of Toledo administration building, the Commodore Perry Hotel, and the Ohio Bell Telephone Co. Building. He also helped design structures in various parts of the country for the Continental Baking Co. and the Willys-Overland Corp. Mem. ASME, 1920. He served the Society as chairman, Toledo Section, ASME, 1925. He was member-emeritus of Toledo Chapter, American Institute of Architects. He was a licensed professional engineer in Ohio. Surviving are his wife; a son, John, Tenafly, N. J.; a daughter, Mrs. Nancy Lee, Malvern, Pa.; a sister, Mrs. Eleanor Morgan, Birmingham, Mich.; and five grandchildren.

Thomas Herron Kerr (1886–1960), retired in 1956 as associate professor-emeritus of chemical engineering, Ohio State Univ., died, Columbus, Ohio, May 27, 1960. Born, Worthington, Pa., March 22, 1886. Parents, Peter and Emma (Herron) Kerr. Education, ME, Carnegie Inst. of Tech., 1909. Married Clarice M. Gilson, 1910. Mr. Kerr was identified continually, since 1909, with some phase or other of engineering and research in the gas industry. He was associated successively from 1909 to 1914 with Bouvaird and Seyfang Mfg. Co., Bradford, Pa.; Tranter Mfg. Co., Pittsburgh, Pa.; and J. A. Snee, Pittsburgh. He designed oil and gas-well machinery, gas engines, and pumps, and perfected patents on air motors and means for automatically charging storage batteries so as to apply the correct load to motors for all speeds and wind velocities. He joined the Ohio Fuel Gas Co. in 1914, where he was an engineer in charge of apparatus for measuring natural gas in large quantities and at high pressures. He worked for several months with the U. S. Bureau of Standards, designing means for commercial determination of the specific gravity of gases. He was an expert in the field of gas-flow measurement and his instruments are in common use. He developed the first successful mercury float differential. Mr. Kerr was vice-president and chief engineer of the Ohio Fuel Gas Co. from 1934 to 1943. He went to the Engineering Experiment Station of Ohio State Univ. in 1943. He retired from the University in 1956. Assoc. Mem. ASME, 1917; Mem. ASME, 1921. He was a member of the ASME Committee on Fluid Meters; and chairman of the Joint AGA-ASME Committee on Gas Meters. He is survived by his wife.

Vernon C. King (1887–1960), supervisor, customer service engineering, Wickwire Spencer Steel Co. Div., Colorado Fuel and Iron Corp., Clinton, Mass., died Worcester, Mass., May 23, 1960. Born, North Easton, Mass., Jan. 28, 1887. Parents, Henry W. and Adella (Randall) King. Education, BS, Worcester Polytechnic Inst., 1909. Married Reba Talbot, 1913; children, Merton T. and Alden H. King. Mr. King specialized in designing wire mill machinery. He was assistant superintendent with Bird and Son, E. Walpole, Mass., 1909–1910; and assistant superintendent and mechanical engineer with George C. Whitney Co., Worcester, 1910–1914. He joined Spencer Wire Co., Worcester, as chief draftsman in 1914. In 1919 the company merged with several others, becoming the Wickwire Spencer Steel Co. Div. of the Colorado Fuel and Iron Corp. Mr. King then took the position of safety engineer for all plants in the Massachusetts district. Mr. King held several patents on wire-conveyer belts for elevated temperatures, and authored the article "Safe Handling of Materials," which appeared in *Iron Trade Review*, July 6, 1922. He was a registered professional engineer in Massachusetts. Assoc. Mem. ASME, 1918; Mem. ASME, 1924. He served ASME as a member of the Worcester Section Committee. He also was a member of the Engineering Section of the National Safety Council. He is survived by his wife.

John Ernest Orrell (1910–1960), chief mechanical engineer, Shell Oil Co., died, Midland, Texas, May 23, 1960. Born, Larimer, Pa., May 5, 1910. Education, ME, Rensselaer Polytechnic Inst., 1934. Married C. Kathryn Johnson; children, John Kenneth, Cathryn Margaurite, Roberta Jean, and Nancy Irene. Mr. Orrell was with Shell Oil Co. Inc. since 1935, spending some time in the company's divisions located at Wichita, Kansas; Tulsa, Okla.; and Wichita Falls, Texas. He later became chief mechanical engineer. He helped to design and supervise the installation of mechanical equipment for oil production, and was especially knowledgeable on the subject of component parts for generating plants. Some major accomplishments included the completion of designs for salt water disposal systems and electric generating plants. He was a registered professional engineer in Oklahoma. Jun. ASME, 1934; Mem. ASME, 1943. Member also, American Petroleum Institute.

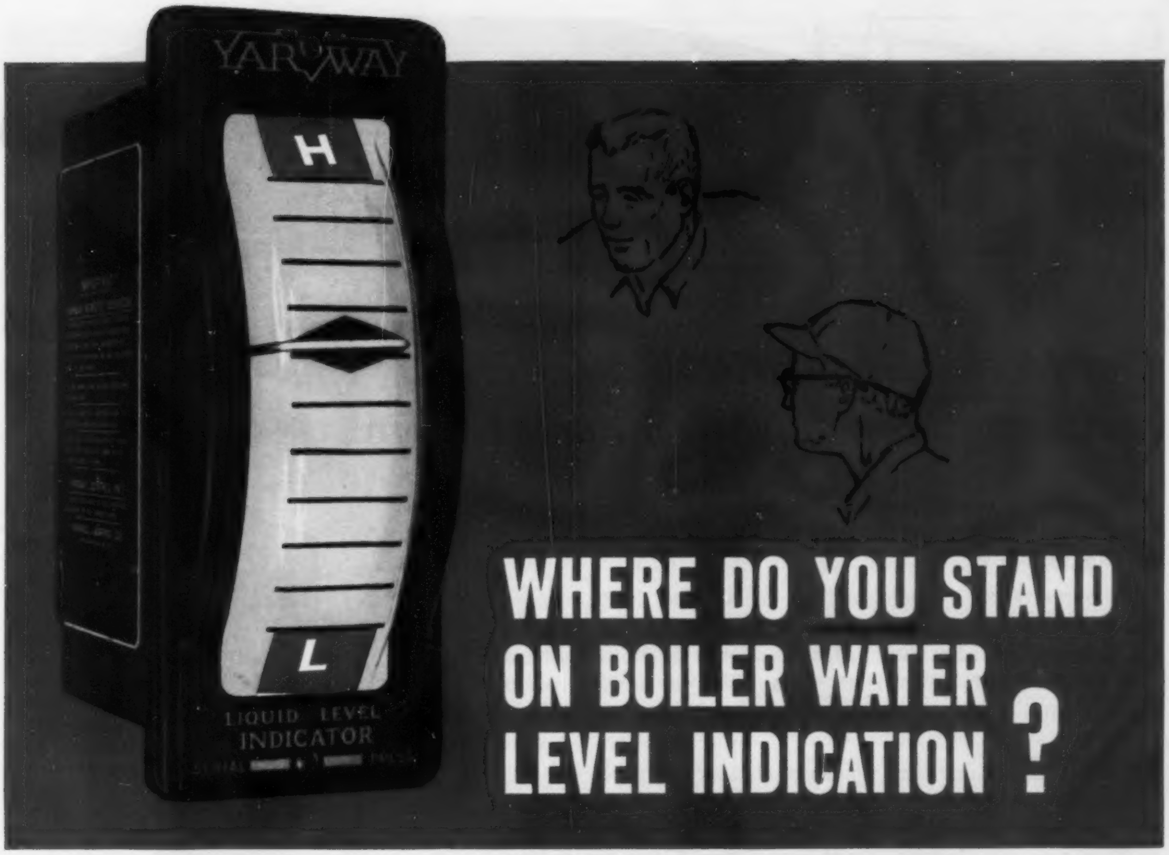
David Heydorn Ray (1878–1960), retired mechanical engineer, died, Tarrytown, N. Y., April 2, 1960. Born, New York, N. Y., July 14, 1878. Parents, Martin H. and Caroline (Heydorn) Ray. Education, AB, City College of New York, 1897; BS, Columbia Univ., 1901; AM, 1902; CE, New York Univ., 1902; DS, 1908. Married Sara Beecher, 1908; child, David T. Ray. Dr. Ray was a former member of the faculties of City College of New York, Manhattan College, and California Inst. of Tech. He was assistant engineer for the New York Rapid Transit Commission and the Baltimore and Ohio Railroad, 1902; examining engineer, Municipal Civil Service Commission, New York City, 1902–1904; and chief engineer, Bureau of Buildings, Borough of Manhattan, New York City, 1910–1912. He was a structural engineer with the Bureau of Buildings, Los Angeles, Calif., 1923–1927; and an examining engineer with the Los Angeles Civil Service Commission in 1927. As a senior structural engineer, he investigated earthquake hazards in the public schools of Southern California cities for the State Dept. of Public Works in 1933. Dr. Ray was a technical civil service examiner for ten years for the Civil Service Commissions of New York City, Los Angeles, and San Diego. He was superintendent of construction for Schickel and Ditmars, architects; and was engaged in private practice as a consulting engineer in New York, where he helped to design a group of buildings at Mount Hope for the New York Institute for the Blind. He was also secretary-treasurer and director of Kensington Mfg. Co., New York, N. Y. He authored a brief history of mechanics; and an ASME pamphlet, "Appraisal Methods," published in 1920. Jun. ASME, 1904; Mem. ASME, 1911. His motto, "By Truth and By Service to Enrich Mankind," was selected as the theme for the celebration of the Society's 75th Anniversary in 1955. He also was a Fellow, AAAS, 1934. He was a member of the National Economic League and the U. S. Ordnance Assn.; and a Captain in the U. S. Army Engineer Reserve. He was a licensed structural and civil engineer in the State of California. He is survived by his wife, Florence G. Ray, and his son, David.

Charles Henry Repath (1864–1960), retired consulting engineer, senior member, Repath and McGregor, Douglas, Ariz., died, Pacific Palisades, Calif., March 6, 1960. Born, Hancock, Mich., May 5, 1864. Parents, Susan and Richard Repath. Education, attended Univ. of Minnesota. Married Minnie Holman, 1892; children, Ruth, Charles, Kenneth, Helen, and Richard. Mr. Repath specialized in building smelters for treating native copper, and iron and copper ores. He started his career as a machinist at the Lake Superior Iron Works, Hancock, Mich. In 1886 he entered the Univ. of Minnesota as a special student in mechanical engineering. After completing a year there he was a draftsman and agent for Lake Superior Iron Works and Portage Lake Foundry, Hancock, Mich., 1887–1890. He was a draftsman and superintendent of construction for the Boston and Montana Mining Co., (now merged with the Anaconda Mining Co., Great Falls, Mont.), 1890–1897; for the same company at Butte, Mont., 1897–1900; for the Anaconda Mining Co., Anaconda, Mont., 1900–1902; and for the International Smelting Co., Salt Lake City, Utah, 1908–1910. He was also chief engineer in New York for the Cerrade Pasco Mining Co., 1902–1904. Mr. Repath was a senior member of Repath and McGregor, Douglas, Ariz., from 1911 to 1915, building smelters for the Calumet and Arizona Mining Co., Arizona Copper Co., United Verde Copper Co., and the International Smelting Co. From 1915 to 1925 he was a consulting engineer in Los Angeles, Calif. He wrote several technical papers on smelting equipment. Mem. ASME, 1891.

Howard Emery Stowell (1889–1960), retired research engineer, died, New York Hospital, May 11, 1960. Born, Clinton, Mass., May 13, 1889. Parents, Nathaniel Emery and Emma (Houghton) Stowell. Education, BS(ME), Worcester Polytechnic Institute, 1911. Married Florence M. Patterson, 1915. Mr. Stowell joined the Carborundum Co., Niagara Falls, N. Y., as a research engineer in 1912, and continued there in various positions until his retirement in 1954. He did experimental work to develop and improve equipment for increased production, including equipment for abrasive wheel finishing, pulp grinding, and allied problems. He was a registered professional engineer in New York State. Jun. ASME, 1914; Mem. ASME, 1921. He was a past-president of the Carborundum 25-Year Club. Surviving are his wife; a son, Charles P. Stowell, Richmond, Va.; a daughter, Leonora G. Stowell, New York, N. Y.; two sisters, Mrs. Burt W. Greenwood, Oklahoma City, Okla., and Carol H. Stowell, New York, N. Y.; and four grandchildren.

J. Howard Williams (1881–1960?), retired mechanical engineer, died, Lincoln, R. I. Born, Henry County, Ga., May 1, 1881. Parents, John R. and Martha Isabelle (Tarpley) Williams. Education, BS(ME), Georgia School of Technology, 1901. Married Minnie Lee Chamblee, 1902; children, Clara Delle, Hazel Annetta, Mary Adeline, and John H. Mr. Williams began his engineering career as an engine and boiler draftsman on battleship design, with the Newport News Shipbuilding and Dry Dock Co., and the U. S. Navy Yard, Brooklyn, N. Y. He was a draftsman for the Board of Water Supply from 1907 to 1918 on the Catskill Aqueduct, New York; and was also a mechanical engineer on the project for nine of those years. Mr. Williams was in charge of constructing several large aircraft and automobile foundries for the Aluminum Co. of America, 1918–1920. He was president of Chaney and Williams Construction Co., Cleveland, Ohio, 1920–1922; chief engineer of Industrial Rayon Co., Cleveland, 1922–1924; and research engineer with Copland Gear Lapping Syndicate, Detroit, Mich., 1924–1927. He was a mechanical engineer with General Fire Extinguisher Co., Grinnell Co., Inc., and other subsidiaries, Providence, R. I., in charge of standards, and plant machine, and product design. He was the author of many technical papers, and held numerous inventions on precision gears, pipe fabricating processes, and many different types of production machines. Mem. ASME, 1924. His committee service in ASME included membership on the Power Piping Code and Flanges and Flanged Fittings groups. He was a member of the executive board of Manufacturers Standardization Society of Valve and Fittings Industry. He was a member of the following ASA committees: Pipe Thread Comm., Fire Hose Coupling Screw Thread Comm., Code for Pressure Piping Comm., Pipe Flanges and Fittings Comm., subcommittee on Screwed Fittings, subcommittee on Malleable Iron or Steel, Brass Seat Unions, Manufacturers Subgroup on Brass Seat Unions, subgroup on Tests and Material Requirements, subcommittee on Cast Iron Flanges and Flanged Fittings. He also served on the committee on Hydrants, Valves, and Pipe Fittings of the National Fire Protection Assoc.; and the Welding and Ferrous Screw Fittings committees of the Manufacturers Standardization Society. He was also a member of the American Welding Society.

John A. Zublin (1886–1960?), president, Universal Engineering Co., Ltd., Los Angeles, Calif. Born, Switzerland, Aug. 5, 1886. Parents, Casper and Catherine (Dieterlen) Zublin. Education, attended Swiss Federal Polytechnical School, Zurich, Switzerland. Naturalized U. S. citizen, Los Angeles, 1928. Married Maria N. Muratova Ivanovska; children, Casper Leonid and Edward Adolphus Zublin. Mr. Zublin assisted his father in the management of Geiger Zublin and Co., Buenos Aires, Argentina, from 1911 to 1914. He helped to import machinery from Europe and the U. S., and to plan and erect power plants, packing houses, heating and cooling systems, deisel engines, dredges, flour mills, and so on. He traveled in Argentina, Uruguay, and Brazil as a sales engineer for the company. From 1918 to 1919 he was a chief engineer for the Argentine Government in the Ministry of War Arsenal, Buenos Aires, where he conducted experiments in metallurgy. Mr. Zublin started his own firm, Universal Engineering Co., Ltd., in Los Angeles, in 1926. He invented and designed radically different oil-well drilling tools, known as Zublin Bits, for modern deep drilling methods. He managed the business plant and sales organization, with branches in California, Texas, and Louisiana, as well as export activity. He authored numerous catalogues on oil-production tools, and was granted more than 85 U. S. Patents since 1923. Mem. ASME, 1930. He also was a member of AIME and the Society of American Military Engineers.



Yarway Remote Indicators have "wide angle" visibility from multiple vantage points

Yarway Remote Liquid Level Indicators bring distant, often hard-to-see boiler level readings right down to eye level on the panel board or other convenient location.

No matter where you stand—at any point in a 180° arc, and from a considerable distance—the brilliant new wide vision dial makes viewing and reading easy.

Accurate readings because Indicator is operated by boiler water itself

Remote readings of levels in boilers (also feed water heaters and other heat exchangers) are instant and accurate because indicator *operating mechanism* is actuated by the varying head of the liquid itself, yet the *pointer mechanism* is never under pressure.

Fully approved under Boiler Code Case #1155

Under A.S.M.E. Boiler Code Committee ruling in Case #1155, two independent remote level indicators of compensated manometric type may be used as primary indicating elements instead of one of the two gage glasses required for boiler pressures 900 psi and above. When both indicators are in operation, one gage glass may be shut off but shall be maintained in serviceable condition.

Yarway Remote Liquid Level Indicators conform to this ruling and are used widely for primary boiler water level indication in plants operating at 900 psi and above.

All Yarway Indicators for service over 700 psi are temperature-compensated; pressure compensation available when desired. Use of controlled-temperature column on constant head chamber fully protects against system upsets.

If you would like a reprint of this Boiler Code ruling, just ask for Case #1155 reprint.

Get the full story on Yarway Liquid Level Indication for your plant. Write for new 24-page Bulletin WG-1825.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY
A MARK OF QUALITY IN STEAM ENGINEERING

TYPICAL USERS OF YARWAY INDICATORS FROM OVER 15,000 INSTALLATIONS	INDUSTRIAL PLANTS WEYERHAEUSER COMPANY GENERAL ELECTRIC COMPANY STAUFFER CHEMICAL COMPANY U. S. STEEL COMPANY GENERAL MOTORS MOBIL OIL COMPANY	UTILITIES (Code Case #1155 Installations) COMMONWEALTH EDISON ILLINOIS POWER CO. WISCONSIN POWER & LIGHT PUBLIC SERVICE OF INDIANA IOWA ELECTRIC LIGHT & POWER	NEBRASKA POWER NEW ENGLAND POWER ROCHESTER GAS & ELECTRIC CO. PENNSYLVANIA ELECTRIC CO. (ERIE, PA.) LOUISIANA POWER & LIGHT POTOMAC ELECTRIC POWER CO.

It's Horse Sense . . .
Why Chance Leaks in Seat Rings

Get Monel Seat BRONZE GATES made the way JENKINS makes them

It's plain horse sense that you had better have the Monel seat rings EXPANDED (ROLLED) into the valve body if you want them to stay tight and leak-proof.

More horse sense . . . there's nothing valuable lost through having seat rings that can't be replaced by a regular maintenance man . . . **IF** the bronze or nickel alloy wedge has a lower degree of hardness than the heat-treated Monel seat rings. *(The way Jenkins makes them)* Then, the wedge takes the wear and seat rings are relatively unaffected.

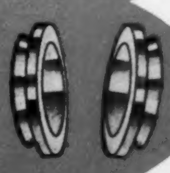
Obviously, there's no faster, simpler or cheaper way to renew tightness and efficiency than to slip on a new wedge. And that, plus renewal of packing as needed, is all you need do to assure good performance from Jenkins Monel Seat Bronze Gates for as long as you'll need to care. Good service for scores of years is common.

Long, low-cost life also results from greater-than-ever-needed strength in every part of these valves. The records of millions of Jenkins Bronze Gates show you get full protection against all the stresses encountered in use.

Your local Jenkins Distributor will quickly supply your needs from a wide variety of Jenkins Bronze Gates. For information about these valves, write for folder No. 181-C. Jenkins Bros., 100 Park Ave., New York 17.

WEDGE is less hard than seat rings. Wear affects this easily replaceable part . . . NOT seat rings

SEAT RINGS are expanded (rolled) into body. Permanent, all-around support is essential to prevent deforming, loosening, shifting, LEAKS



JENKINS VALVES

LOOK FOR THE JENKINS DIAMOND

JENKINS SINCE 1864

Jenkins Bros

Sold Through Leading Distributors Everywhere

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NEW EQUIPMENT

Pin-Type Bearings

Machine builders, whose equipment is designed with double-cup bearings in floating positions, requiring loose cup fits, can now use Timken Roller Bearing Co. new pin-type double-cup bearing. Dimensional interchangeability makes minimum changes to existing designs necessary.

The pin-type bearing offers distinct advantages to machine builders in bearing applications where there is an inherent tendency for the outer race or cup to creep or turn in the housing; where experience indicates that a cup-locking device is desirable.

A hollow pin, located in the housing, fits into the large countersunk hole in the cup OD with ample clearance. Axial float, normally required as a result of shaft or housing expansion, is not restricted, though the pin prevents the cup from turning in the housing. Positive bearing lubrication is assured by introducing lubricant through the hollow pin, direct to the center of the bearing.

A typical pin-type bearing application is in the rear floating position on machine-tool spindles.

Various methods of pinning cups are possible. Additional engineering assistance and data may be obtained. **—K–1**

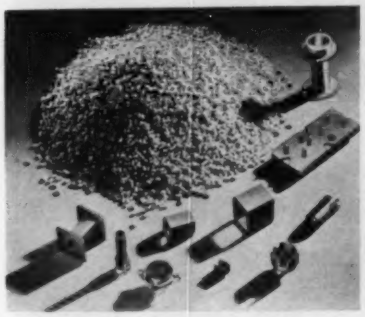
Magnet

A permanent magnet for lifting cans and other light materials is being offered by Stearns Magnetic Products, Div. of Indiana General Corp.

A manual-discharge mechanism easily releases the load. The operator simply presses a pair of handles which, in turn, push a stainless-steel cover plate away from the face of the magnet. The load is then forced out of the magnetic field and released from the unit.

Indox ceramic permanent magnets provide the magnetic power. The magnet has proved highly useful in removing cans from cartons and placing them on conveyer belts for further processing.

The use of permanent magnets eliminates electrical expense, and there are no coils to fail, no dangers from power failure, and no maintenance costs. **—K–2**



Molding Composition

Crane Packing Co. will produce a new molding powder of DuPont's Teflon 100-FEP resin compounded with inorganic reinforcing materials, such as Fiberglas and graphite.

Very similar to the industry-famous Teflon-TFE, Teflon 100 has been primarily developed for injection molding. This makes possible many new applications for Teflon hitherto impractical because of high fabricating costs inherent with Teflon-TFE. The properties of Teflon 100-FEP are considerably enhanced for many applications through the addition of a filler. This filled material is stiffer, has a smaller shrinkage factor (up to 50%) in molding operations and has better wear resistance than the unfilled Teflon 100. Typical applications include coil forms and bobbins, tube sockets and connector assemblies for electronic purposes and incapsulation and lining of valve components and similar parts for chemical service.

The company is now in a position to supply Teflon 100-FEP resin filled with 10 or 20 per cent Fiberglas to injection molders. **—K–3**

Front-Panel Mounting for Timers

Front-mounting convenience for all Automatic Timing & Controls, Inc. Atcotrol timers is now available. The plastic dial assembly employs two screws, lower left and upper right, which flush mount the timer to the panel. Studs at lower left and lower right guide the mounting, thus increasing rigidity and balance appearance.

Ideally suited for installations where rear mounting is impractical, this new front-panel mounting is also suited for odd-shaped panels requiring front-mounted instruments.

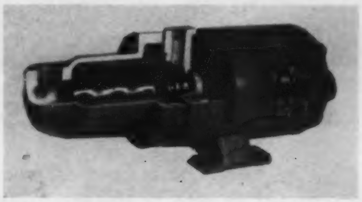
Copies of Engineering Data Sheet No. 86 are available. **—K–4**

Speed Reducer

A new model fin-and-fan cooled worm-and-gear speed reducer, designated the Series S-13, has been announced by Ohio Gear Co.

The unit is designed for horizontal right-angle drive with the worm below and is capable of delivering up to 80 per cent more capacity than comparable nonventilated models of equal size. The increased capacity is reflected in far smaller space requirements for the new reducers. It employs a worm-and-gear reduction and features heavy-duty ball bearings in all shafts.

The Series S-13 is a highly versatile model developed to accommodate a wide variety of design situations. It features heavy bearing capacity, shorter center distance between worm and gear and improved heat-dissipation characteristics. The reducer is available in a complete range of sizes from 1.33 to 5.25-in. center distance in ratings ranging from $^1/_{16}$ to 18 hp. **—K–5**



Coolant Pumps

Positive delivery of coolants at one or more constant pressures is provided by Pres Sure Kool pumps which employ the Moyno principle developed by Associated Engineers. An abrasion-resistant helical-screw rotor turning in a stator has proved most effective for positive displacement in pumping heavily contaminated coolants and cutting oils, particularly where suction or pressures are demanded. Free from turbulence and vibration, they can be mounted either vertically or horizontally on a machine with suction line piped to coolant tank.

Capacity and pressure capabilities permit many outlets. Some may be under pressure to operate a chuck, direct the flow of chips, or provide vertical delivery of coolant, while other outlet pressures may be relieved.

Positive action may eliminate manual control and allow the pump to operate automatically with tool-head movement. Motorless units may be powered by drive shaft or separate motor serving dual function.

Descriptive literature is available. **—K–6**

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Differential-Pressure Transmitters

Series BB-25 differential-pressure transmitters have been introduced by Consolidated Controls Corp., a member of the Condec group of companies.

Originally designed for detecting liquid levels in shipboard nuclear secondary plant-instrumentation systems, the transmitters are equally applicable in general use for flow and differential-pressure measurement and transmission.

The units measure the difference in pressures between two points in a fluid system and transmit the information as an electrical output which can be used directly for indication and/or control with available industrial instruments.

Differential pressures are detected in a Ni-Span-C sensing capsule. A slug secured to the capsule is magnetically coupled to a linear differential transformer. Because the moving transformer slug is linked magnetically with the windings, all hydraulic pressures are contained in a heavy-walled structure. There is no need for the special seals required where a moving mechanical element must pass through the wall of the pressure container. Use of an electrical-symmetry-sensing circuit makes the detector readily adaptable to a square-root extraction for direct readings of flow.

The standard model measures differential pressures from 0 to 80 in. of water directly. The span can be adjusted to provide full output signal over the upper 30 per cent of this range. Units are also available to measure differentials up to 220 psi.

Electrical output over the range of differential pressures varies from 0 to 1 milliamp d-c into a 750-ohm load. A self-contained regulator and demodulator maintain linearity despite variations in excitation voltage.

—K-7

For Consulting Engineers Turn to Page 179

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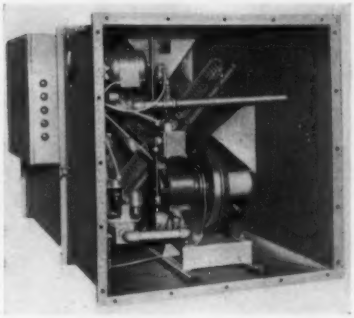

Intake-Air Units

A redesigned line of gas-fired air-intake units for supplying make-up air to replace that removed by exhaust systems is available from the Hartzell Propeller Fan Co.

Four basic units give a capacity range of 15,000 to 90,000 cfm (1,000,000 to 7,000,000 Btu per hr.). The basic units include the burner, controls and belt or direct-driven fan in a single housing, and assembled to meet job requirements with optional accessories including turning elbow, shutters, filter house, and outlet diffusers. Controls systems can be supplied to meet all operational local-code and insurance-agency approval requirements. **—K-8**

Flexible Drive Shafts

Stow Mfg. Co., has marketed unique heavy-duty power-drive flexible shafts. They are designed to transmit a considerable amount of rotary power over any curved path and have many applications in manufacturing plants and for providing power-take-off auxiliary drives on trucks and tractor trailers. The Stow splined flexible shaft has a 1-in-diam core which is capable of power transmission up to 760 in-lb of torque at a speed of 600 rpm.

Layers of tightly wound high-grade music wire make up the essence of this core. The heavy-duty flexible casing is lined with oil-tempered spring steel which acts as a bearing surface for the core, and is reinforced with wire braid. The casing is covered with an oil-resistant, neoprene-impregnated fabric and an abrasion-proof rubber jacket. Extra reinforcement can be put on either end or both if desired.

This new Stow heavy-duty power-drive flexible shaft is equipped with a splined slip coupling at one end which will slide back and forth under load to take care of slight changes in length caused by varying load conditions. Couplings of various bores are available for connecting up at teach end. Steel-backed bronze sleeve bearings support the core at each end of the shaft. This new Stow flexible shaft is available cut to any required length. **—K-9**

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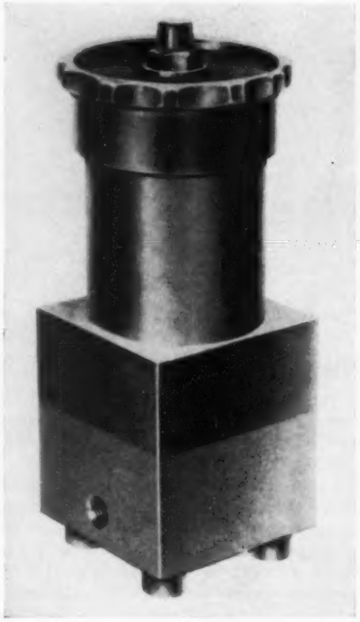

Reducing and Relief Valve

A pressure-reducing and relief valve for water, oil, air, and gas service to initial pressures of 4000 psi is announced by Atlas Valve Co.

Available in $^1/_8$ and $^1/_4$-in. sizes, the 3850 Type F valve is used to control small units under test or to supply a process or piece of equipment requiring small capacity. Adjustable pressure ranges are 0–1000, 0–2000, and 0–3500 psi and pressures can be controlled within as little as 2 to 3 psi over the entire adjustable pressure range.

The single-seated, spring-loaded, diaphragm-actuated valve is simple in design, containing neither external actuating connections nor stuffing boxes. The body is constructed of heat-treated aluminum bar stock with bronze and Monel trim. **—K-10**

Repairing Concrete

A thin surface coating which can be applied to old concrete to repair cracks, spalled and scaled areas, and fill depressions provides a new, nonslip, wear resistant surface which will firmly adhere to old concrete, and resurface unsightly areas.

Called Nu-Surface Concrete and made by the Carborundum Co., it can also be applied to blacktop, sealed wood, and metal. Dry mix and 1 pt of wet material are enclosed in a 1-gal mixing can and will cover 25 sq ft of surface at $^1/_{16}$-in. thickness. Contents of the small can are added to the dry mix, mixed thoroughly, and applied with a trowel.

—K-11

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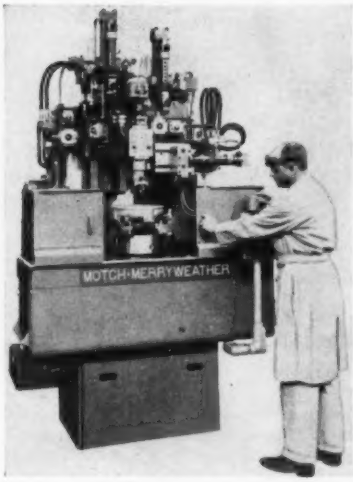

Vertical Turners

Vertical Turners that are actually custom-built to meet the customer's requirements for boring, facing, or turning, either in rough or finished form, have been introduced by Motch & Merryweather. Building-block components are assembled to make a machine which has one or more spindles, with many hydraulically controlled tools on slides mounted on columns to remove metal as required by the job specifications.

This machine tool is unique in its ability to make a mass chip-removal attack on the object being turned. On a motor end-bell, for example, a number of machining operations occur simultaneously. Several different diameters can be rough-bored and turned and then finish-bored and turned. The old method required two separate chuckings on conventional equipment and consumed a total of 11.6 min. The vertical turner speeds through the task in just 46 sec.

To start the operation, the operator simply places the end-bell into position and presses a button, activating the chuck which grips the piece firmly. Pressing another button, the vertical turner goes through a complete machining cycle without further manual control. Rough and finish boring of the turning are accomplished in one smooth, hydraulically controlled movement. This is controlled through a vastly simplified programming system, which a production man of average training and intelligence can change to suit production requirements.

Micrometer adjustments of the positive stops in the hydraulic-slide movement imparts a degree of accuracy extremely difficult to achieve in such a high-speed, high-production machine tool. Several have been purchased specifically to secure the degree of accuracy and speed offered by the vertical turner, which was not available in any other machine tool of similar capacity and price. —K-12

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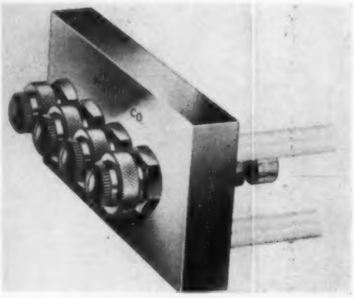

Atomizing Nozzles

Spraying Systems Co. will manufacture pneumatic atomizing-nozzle assemblies to customers' specifications to provide special design characteristics in terms of nozzle positioning, spray projection, mounting, and control. Either standard or special fluid and air nozzles are employed and mounted to specially built body assemblies. The need for special nozzles of this type is usually the result of space limitations in the mounting location or area.

Outline your requirements. **—K-13**

Manometers

A redesigned and expanded line of well-type manometers is announced by King Engineering Corp. for measuring pressure, vacuum, and differential pressure in plants and laboratories.

Models include single-tube manometers with low well for measuring gage or differential pressure, with raised well for measuring both pressure and vacuum, and with raised well for measuring absolute pressure; a flowmeter manometer, with three-valve manifold and return well; an eight-scale instrument test manometer; multitube manometers with fixed-position wells and 2 to 20 tubes; and multitube models with fixed or adjustable common wells and 5, 10, 15, or 20 tubes.

All of these manometers have wetted metal parts of carbon steel or 300-series stainless steel, as ordered. Low-well and raised-well models are available in 17 ranges from 6 to 130 in., for pressures to 250 psig. Single-tube manometers can be furnished for wall, pipe, table, flush-front, front-of-board, or hook mounting; and a choice of eight standard scales is offered.

Construction features include a front cover with glass plate mounted in rubber for resistance to breakage; case of heavy formed-steel channel, welded to end plates for added rigidity; scale-adjustment knob at the front; splash-proof flow-control drain plug; and demountable well to facilitate installation and cleaning. **—K-14**

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Stroboscopic Tachometer

A completely new design of the stroboscopic tachometer, sold for many years under the trade name, Strobotac, and widely used in the mechanical and electrical industries for the measurement of rotating machine-part speeds and observation of their operation is slow motion, has been announced by the General Radio Co.

Small and portable, the new model, Type 1531-A, features a fundamental speed (flashing-rate) range of 110 to 25,000 rpm and brilliant white-light flashes with extremely short duration—1 to 6 microsec—permitting fast action to be "stopped."

A specially developed Strobotron lamp produces the high-intensity flashes with peaks of 0.21, 1.2, and 4.2 million candle power on three speed ranges—high (4000–25,000), medium (670–4170) and low (110–690). The single-flash rate peak is 7 million candle power. An electron pulse generator controls the flashing rate.

The light is housed in a parabolic-reflector assembly, the reflector swiveling around the lamp so that the light can be directed toward practically any point.

Speeds of up to 250,000 rpm also can be measured by using flashing rates that are submultiples of the speed to be measured.

The instrument can be calibrated by making two screw driver adjustments against power-line frequency.

Accuracy of the new Strobotac is ± 1 per cent of the dial reading after calibration on the middle range.

The case is $6\frac{1}{4} \times 5\frac{1}{2} \times 8\frac{3}{4}$ in. and over-all weight is $7\frac{1}{8}$ lb. —K-15

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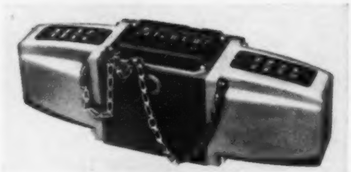

Directional Control Valve

A new versatile and compact solenoid-operated four-way directional control valve has been announced by Vickers Inc., Div. of Sperry Rand Corp., for the many directional control requirements of hydraulic machinery.

The valve has a nominal rating of 8 gpm and can handle flows up to 12 gpm without malfunction. For its physical size, it is claimed that the unit has the highest flow capacity, at reasonable pressure drops, of any valve known to be available. Subplates are furnished with $^3/_8$-in. ports, or with $^1/_2$-in. ports to take advantage of the larger flows. Maximum recommended operating pressure is 3000 psi.

The valve incorporates improved air-cooled solenoids which are retained in their cover rather than being mounted separately. In addition to quiet and cool operation, shock-free performance is assured through superior cushioning.

From the standpoint of endurance, the solenoids have several times the life of any air-cooled selenoids for this type of valve now on the market. They are rated for 115-volt, 50 or 60 cps a-c service. The same valve also is available with oil-immersed solenoids. **—K-16**

Draft Gages

A line of single- and dual-tube draft gages for measuring boiler-room pressure, furnace, and oven drafts and other low-pressure phenomena is announced by King Engineering Corp. The single-tube gages are available in six ranges, with maximum pressure readings of $^1/_2$ to 4 in. of water. Dual-tube gages are offered in four ranges, with maximum readings of $^1/_2$ to 2 in. of water, and can be furnished with a different range for each tube. All models have an 11-in. scale, graduated in increments of 0.01 in. of water for gages up to 2-in. range and in 0.02-in. increments for gages of 3 and 4-in. range.

These instruments are furnished for wall mounting as illustrated for flush mounting, or with a base for table mounting. Construction features include a case of heavy formed-steel channel, welded to end plates for added rigidity; front cover with glass plate rubber-mounted to resist breakage; built-in spirit level and level-adjusting screws; tube-cleanout plugs at both ends; and a screw-operated zero adjustment for liquid level. Wetted metal parts are aluminum or 300-series stainless steel, as ordered. **—K-17**

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Manifold Valve

A compact and leakproof manifold valve, P-727 series, containing three valves in one unit, is available from Circle Seal Products Co. The P-727 is specifically designed for use with differential-type measuring, recording, or transmitting instruments in chemical plants, refineries, pilot plants, test labs, and research labs.

Complete absence of cross-port leakage in the P-727 eliminates a major cause of inaccurate instrument readings. One variation of the P-727 provides a bleed hole that vents both instrument ports to atmosphere when the balancing valve is open. Another variation replaces the basic five-valve assembly.

Made of brass and Type 303 stainless steel, with operating pressures from 0 to 2000 psi, the P-727 is suitable for use in systems containing air, alcohol, ammonia, argon, helium, hydrogen, hydrocarbons, base oils, natural gas, nitrogen, and so forth.

Circle Seal O-rings prevent interport and body leakage and dead-tight shut off. They seal automatically. **—K-18**

Optical Leveling Kit

An optical leveling kit designed to increase the speed and precision of all industrial leveling operations has been placed on the market by Keuffel & Esser Optics and Metrology Div.

Optical leveling, company engineers state, offers distinct advantages over conventional leveling techniques. No lines need be stretched; no spirit levels, straightedges, surface plates, gages, or indicators are required. Optics provide a plane of reference which is absolutely flat and weightless. And readings to 0.001 in. are easily made.

The principal components are a highly accurate tilting level, an optical micrometer, and specially designed K&E Wyteface scales. The kit, in a reinforced wooden case, is lightweight (23 lb) and completely portable.

Among industrial uses are: (*a*) Foundation and bed-plate leveling, (*b*) differential leveling, (*c*) profiling (the measurement of irregular or curved surfaces), and (*d*) checking the movement or settling or heavy equipment. **—K-19**

Speed Reducers

Model 221 Optimount reductors and ratiomotors extend the ratings of helical-geared speed reducers to meet increasing needs for drives in the lower power range.

Like the larger Optimount models, the 221 size is available, from stock, in horizontal or vertical-base mounted, or shaft-mounted designs—to meet any mounting conditions.

Ratings and specifications of the new Model 221 Optimount are listed in the New Products Supplement to the Catalog No. 57. **—K-20**

Fastener

A new fastener called the Fastite nut combines a nut and helical-spring washer which are permanently held together but free to rotate when pressure is applied.

Made by Eaton Mfg. Co., the outstanding feature is the incorporation of the helical spring washer designed to give a greater reactive range and higher spring tension. High reactive range and spring pressure mean a considerable reduction in the incidence of failure of bolted assemblies due to bolt stretch, thread creep, and linear dimensional changes caused by rapid thermal expansion or contraction, according to the company.

For complete details, including comparative spring-tension curves, write for Fastite Nut Engineering Bulletin. **—K-21**

Pillow Blocks

Heavy-duty pillow blocks, with self-aligning spherical roller bearings in split housings, are available in 143 sizes from the Torrington Co., Bantam Bearings Div.

Two heavy-duty series are offered—Series SAF, with two bolts clamping cap to base, and Series SDAF, with heavier castings and four cap bolts. All sizes are available with straight-bore bearings for shouldered shaft mounting, or with adapter bearings suitable for mounting on straight commercial shafting.

Housing seats are machined to bearing widths plus $^3/_8$ in. This permits each Torrington pillow block to be used as a floating unit or, with standard $^3/_8$-in.-wide stabilizing ring in place, as a fixed pillow block.

The Torrington spherical roller bearings used in the new pillow blocks have high radial and thrust-load capacities combined with low torque. The internal self-aligning feature of the bearing permits a reasonable latitude in alignment of pillow blocks during installation and operation. An integral guide flange, adding strength to the bearing inner ring, guides the rollers and prevents roller skew. Precision-machined bronze retainers for each row of rollers are land riding to reduce friction, provide quiet operation and cool running. Open-end retainer pockets allow lubricant to reach all contact surfaces.

The split housings are manufactured from high-grade, stress-relieved cast iron. Cast-alloy steel caps and bases are also available. Housing design accommodates either grease or oil-bath lubrication and is easily adapted to circulating or oil-air mist systems. Triple labyrinth seals retain either oil or grease and prevent entrance of dirt. The close running clearance of the seals, without rubbing contact, allows them to operate under conditions of normal misalignment.

Request Catalog 860. **—K-22**

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Feedwater Heaters

A new feedwater-heater design with a hemispherical inlet chamber and a new type of joint between tubes and the tube sheet is available from the Westinghouse Electric Corp.

The improved type of joint between tubes and the tube sheet has been made possible because of techniques developed for the construction of nuclear steam generators. In the past, tubes have been welded directly to a forged carbon-steel tube sheet. Now, a layer of nickel and additonal layers of nickel-copper alloy are welded onto the surface of a conventional tube sheet, and tubes are then welded to the cladding.

This clad-tube-sheet process makes joints which are metallurgically compatible with the tube material so that thermal stresses are minimized. The result is strong, reliable welds.

The automatic equipment used to clad the new-design feedwater heaters can produce high-quality welds with either ferrous or nonferrous materials, including carbon steels, austenitic stainless steels, copper-nickel alloys, and high-nickel alloys. —K-23

Wound-Rotor Motors

A new line of wound-rotor motors completely redesigned to meet NEMA standards in frame sizes 213 to 326 U is available from the Louis Allis Co.

The new design features substantial reductions in both size and weight while retaining durable cast-iron housing and end-bracket construction with oversize grease reservoirs for maximum protection against shock and corrosion, and to insure minimum maintenance. The rotor is precision wound and has both ends dynamically balanced for quiet, vibrationless operation. Rotor end coils are banded with an epoxy Fiberglas to form a bond stronger than steel and remove any possibility of end-coil shorts due to wire cutting insulation.

Other important features include: Improved secondary characteristics to reduce control and installation costs; low rotor-inertia design for greater response; rugged collector and brush assemblies to add reliability; plus an advance Class B insulation system for greater protection against moisture, oil, dirt, weak acids, and abrasive dust.

These motors are suited for elevators, cranes, hoists, printing presses, and similar applications. They can be furnished with open, drip-proof or totally enclosed, nonventilated enclosures for horizontal, ceiling, or side-wall mounting. —K-24

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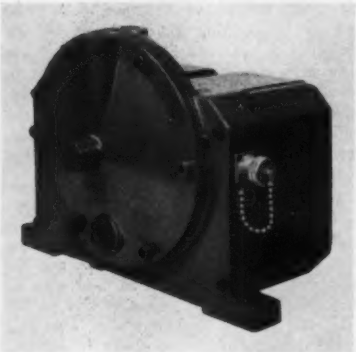


Furnace-Pressure Transmitter

Designed for open-hearth furnaces, soaking pits, slab-heating furnaces, glass tanks, and similar applications, Model R787 furnace-pressure transmitter has been announced by GPE Controls, Inc.

The transmitter is provided with atmospheric-pressure compensation, because in the pressure range for which it is designed, the normal atmospheric-pressure change over a few feet vertically can easily exceed the required accuracy of the transmitter. Standard differential-pressure range is from −0.05 to +0.15 in. w.c. Accuracy is ±1 per cent of range, or ±0.002 in. w.c. The unit is insensitive to changes in static pressure.

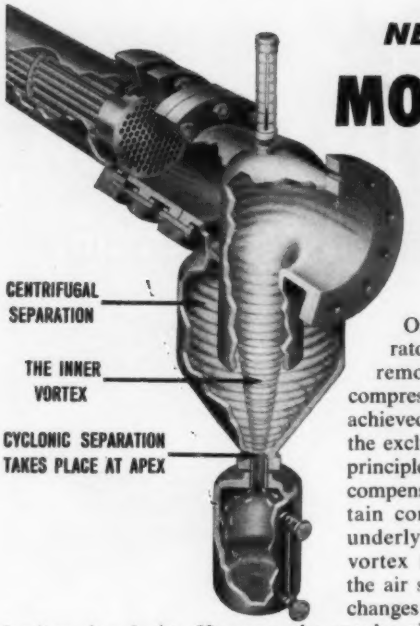
Output of the transmitter is a d-c voltage signal in the range of 0 to 25 volts. Output power can be as much as 5 watts. This signal is great enough to be used directly and simultaneously by standard d-c recorders and indicators, analog-to-digital converters, and electrohydraulic valve actuators. Standard unshielded transmission lines can be used over great distances, many times greater than with low-power transmitters.

Using force-balance principles, measured pressure on the diaphragm is converted into the output voltage through an integral transistor amplifier. Simple calibration adjustments are provided. Complete information is available in Folio T4. —K-25

Angle Check Valve

Extractable angle check valves are used in the suction line of gasoline and fuel-oil storage tanks to prevent drainage when pumps are inactive and to maintain fuel in the lines for instant dispensing. Connected to one of the $3^1/_2$-in. tank openings, accessibility is obtainable through a covered pipe.

Universal Valve Co. has announced the conversion of a standard $1^1/_2$-in. angle check valve to 2-in. inlet and outlet openings. In addition to the economy of a smaller valve, the Model No. 410 also eliminates the need for the reducers required when a standard $1^1/_2$-in. valve is made to accommodate a 2-in. line. —K-26



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Overflow Check Valve

King Engineering Corp. announces the Series 8838 overflow check valve, for use with manometers and liquid-level gages to prevent blowing-out of the indicating liquid. Installed at the top of the instrument, the valve closes instantly at the onset of overpressure and opens automatically when the overpressure is removed.

This check valve has operated without failure in tests through more than 200,000 cycles, with only ordinary care in preventing dirt or contamination from reaching the manometer liquid. It can be used with all indicating liquids, at pressures up to 500 psig, and can be furnished with inlet and outlet threaded to fit practically all manometer and gage installations. **—K-27**

Filter Shaker

A highly efficient automatic filter shaker has been developed for all models of Torit Mfg. Co. cloth-filter-type dust collectors.

In addition to assuring peak operating efficiency by thoroughly shaking the filters each time the dust collector is used, the self-cleaning device eliminates the possibility of a workman forgetting to manually shake them.

The automatic shaker is powered by an independent electric motor mounted on the side of the collector. When the shaker bar is oscillated horizontally, its metal fins strike each cloth filter bag to free the dust particles and cause them to drop into the dust tray.

Shaking action begins automatically whenever the collector motor is turned off. After shaking the filters for 2 min, the mechanism shuts itself off and will not operate again until the collector has been turned on and off again.

Available with single-phase, 110 or 220-volt, 60-cps motors, the shaker can be used regardless of the voltage of the collector. **—K-28**

Porous-Metal Filters

Purolator Products, Inc., has announced a porous-metal filter element utilizing a special pressure-lock manufacturing process which eliminates all defects and contaminants resulting from welded or cemented construction.

The new porous metal pressure-lock filter element—developed specifically for nuclear application—is designed for 5-micron or more filtration and operating pressure of 15 psi. One unit, made of Monel, is designed for 36 cfm of air per sq ft with a pressure drop of 0.2 psi and operating temperature of 400 F, and the other unit, made of Inconel, for 5 cfm of air per sq ft with a pressure drop of 1 psi and operating temperature of 800 F. Both units measure 36 in. long and $2^3/_4$ in. OD, with 1-in. pipe connections, and are 100 per cent bubble tested for uniformity of pore size. **—K-29**

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Environmental Test Chamber

A temperature test chamber for −300 to +1000 F—said to be the widest range available in a single chamber—has been announced by Missimers Inc.

Designed to be used with a vibration exciter in combined environmental testing, this new, self-contained chamber is equipped with casters for portability, and is adjustable in height to accommodate various sizes and types of vibration shakers.

This wide temperature range is said to provide a break-through in chamber construction, where expansion and contraction have restricted the over-all temperature range. The wider range will allow greater accuracy and reality in simulation of temperatures. High-temperature operation of this combination chamber is accomplished by electrical heating with temperatures from ambient to +1000 F in 45 min. Expendable refrigerants provide the cooling, with CO^{2} used for economy where moderate low temperatures are desired (ambient to −100 F) in approximately 20 to 30 min. For lower temperatures, liquid nitrogen is used for −90 to −300 F in 20 min.

Controlled circulation of air at both high and low temperatures provides close temperature uniformity throughout the chamber working area.

Accuracies are held to close tolerances by two control instruments with one for the high range for ± 3 deg to 1000 F, and the other holds ±1 deg in the low temperature ranges.

The first of these new chambers is being used with a vibration system in the checking of fuel-distribution valves under various combined environmental conditions.—**K-30**

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Subminiature Force-Control Switch

Many industries using conveyer and transfer lines, automatic processing machinery, or tape programming can use thousands of tiny new subminiature force control switches, manufactured by W. C. Dillon & Co.

Automatic starting and stopping of motors, activating of equipment in sequence, tripping of relays, and registering of warning sounds or visual signals are typical of the many applications. Their amazing versatility and subminiature dimensions (approximately $1^7/_8 \times {}^5/_{16} \times 1$ in.) allows mounting in the most crowded quarters. Weight is only $^1/_4$ oz. Accuracy is within 0.5 per cent.

Three different capacities are offered in the subminiature line: 0 to 5, 0 to 30 and 0 to 100 lb. These can be set to operate at any desired point within their respective ranges. Viz: the 5-lb capacity can be set for 1, 2, 3, 4, or 5 lb. All units are calibrated for any specified operational point prior to shipment. Sealed weights are used, and either tensile or compression models can be supplied.

Other Dillon force control switches are also available in capacities from 0-100, 0-1000, 0-5000, 0-10,000, 0-25,000 and 0-50,000 lb. Units can have up to 4 micro-switches for closing or breaking circuits at preset intervals. Tensile or compression models supplied in all capacities. **—K-31**

Pillow-Block Bearings

A compact, improved line of pillow-block bearings, available in a wide range of shaft sizes from $^1/_2$ to $1^3/_{16}$ in., has been announced by the Hoover Ball and Bearing Co. Designated EDX series, these economical bearings utilize housings of ductile material and are designed for light and medium-duty service.

Improved retention of lubricant and exclusion of dirt results from the adoption of an improved lip-type seal. Constructed of a rubber-impregnated fabric between metal shields, the seals efficiently maintain positive contact with the inner bearing ring at all times, regardless of shaft misalignment. Factory-applied lubricant lasts for the life of the bearing.

The new pillow-block bearings, and the companion flange bearings, utilize an eccentric locking collar to secure the inner bearing ring to the shaft. A setscrew assures positive locking.

The new EDX pillow block and FEDX flange units are made with Hoover-Honed raceways and Micro-Velvet balls. They are completely interchangeable with Hoover's ED and FED units and offer the same load capacity. **—K-32**

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6, 7	20	31	44, 45	131	143R	155	172
8	21	32, 33	46	132	144	156	181
9	22	34	47	134	144L	157	182
10, 11	23	35	48	135	148T	159–162	IFC
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KEEP INFORMED — BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Vacuum Pump

A unique electrical vacuum pump, the PDV-30 DriVac, achieves a higher ratio of pumping speed per unit volume and more stable pressures than any comparable vacuum ion pump according to the manufacturer, Consolidated Vacuum Corp., a subsidiary of Consolidated Electrodynamics. First in a line of new vacuum ion pumps, it was developed to overcome the disadvantages of the two-element Penning discharge pump. A "sputtering cathode" was added to achieve a three-electrode construction which greatly enhances pumping speeds and eliminates pressure surges in the pumping of inert gases. Speed is claimed to be five times faster, size for size, than any other vacuum ion pump (air, 25 liter per sec; argon, 8 liter per sec; methane, 28 liter per sec; hydrogen, 15 liter per sec). Speeds remain constant over the entire pressure range of the pump and there is no saturation or falling off of pumping speed with time. The three-electrode construction minimizes pressure instabilities and improves ionization of inert gases.

A sturdy structure of simple design, it occupies only $1^1/_2$ sq ft and weighs less than 90 lb. Lack of moving parts limits wear to the "sputtering cathode." This has a life of over 10,000 hr of reliable service at 1×10^{-6} mm Hg. Replaceable electrodes are available and easily installed.

Ultimate pressures to 1×10^{-10} mm Hg or lower are available with the stainless-steel DriVac pump when properly baked. The pump itself will accept baking temperatures to 450 C. No baffles or cooling are required and speed at the mouth of the pump is the speed of the system.

Typical applications include semiconductor processing, thin-film work, vacuum-tube processing, electron-microscopy, mass-spectrometry, particle-acceleration, field-emission, electron-beam and molecular-beam studies, ultrahigh-vacuum research—any field in which high-speed pumping with a dry vacuum is required. Ask for Bulletin 6-145.

—K-33

Electric Motion Control

Three new Warner Electric Brake & Clutch Co. products provide improved electric motion control for various types of machinery.

First is a new spline-drive armature especially suited to clutch and brake applications where shock, vibration, or severe duty are present, providing automatic compensation for magnet and armature wear insuring a proper running gap when disengaged.

Second is the Warner Electro-Sheave, a clutch-pulley package for direct installation on standard NEMA electric-motor shafts.

A third will be new miniature electric clutches and brakes designed to handle torque loads up to 1.5 lb-in. Compact design (1-in-diam × $^7/_8$-in-length) provides high torque per size while controlling complex mechanical movements within limited space.

—K-34

KEEP INFORMED

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Drip-Proof Motor

Sterling Electric Motors, Inc., has announced design modifications of its 364U a-c drip-proof motor. With horsepower ratings ranging from 20 to 40 hp, it incorporates all the advantages of the Sterling multi-shielded protection, being shielded five important ways against environmental hazards. The shielding includes a splash-resistant enclosure, bearing cap, labyrinth seal on the output shaft, double-shielded ball bearings and high dielectric insulation of the winding.

This frame is also available with Sterlicone shielding, Sterling's exclusive new stator insulation. **—K-35**

Metal-Cutting Tool

A new design of metal-cutting tool that incorporates a mechanism for maintaining optimum machining conditions has been developed by Kennametal Inc.

It provides close control of the metal chips that are removed in machining operations with hard-carbide "throw-away" inserts. Specifically, it enables the screw adjustment of chip-breaker plate position on Kendex tool holders to control chip form.

Since the size and form of the chip removed by the cutting edge are also affected by the physical characteristics of metals being machined, and by the variable speeds, feeds, and depths of cuts made by a machine, proper compensation can now be made readily, when required, by chip-breaker plate position. Stepless adjustment of the chip-breaker replaces the use of chip-breaker plates of many sizes which serve a similar purpose.

This new adjustable holder is called the Dial-A-Breaker Kendex holder. Its design provides for easy adjustment of the chip-breaker regardless of its position, as on semiautomatic machines, and under conditions of close ganging of tools. The adjusting nut is on top of the tool and is exposed more than 180 deg for turning. The insert clamp can be loosened and tightened by an Allen wrench from the top or bottom of the holder.

In order to meet every service requirement, Kennametal makes the holder in 76 styles and sizes. These tools are available with positive or negative rake angles, in either right or left-hand styles. **—K-36**

Combination Air Eliminator and Flow Check

A combination air eliminator and flow check designated Type 5000 has been introduced exclusively by Watts Regulator Co., as a unique new design for hot-water space-heating systems. A one-piece casting, it includes an air eliminator, flow check, and automatic air vent. A tapping is available for the expansion-tank line.

Because its internal construction creates a flow path which directs air to the surface for fast removal, the air-eliminator portion provides noiseless, efficient air elimination. The flow check prevents gravity flow and permits summer operation of the domestic water unit. A Type 5100 is furnished without the flow check and air vent for use as an air eliminator only.

Watts visualizes a large market for it because of its initial low cost and the fact that it eliminates the need for contractors to stock and install several separate devices to achieve the same result. Installed directly on the riser, installation is faster and less expensive. **—K-37**

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Heat Exchangers

Brown Fintube Co. has developed a low-cost, double-pipe heat exchanger, with greatly amplified assembly, disassembly and maintenance features.

The tubeside connection and the tube side closure in these units require only two $\frac{3}{4}$-in. alloy-steel studs each, which reduces the cost of the exchangers over conventional double-pipe units requiring a complex bolting arrangement.

Economies are further obtained by a simplified hammer-lug design which locks the head-to-tube closure into place by means of one large, forged, hammer-type nut. The hammer ring is easily accessible from the front end which makes the unit easier to disassemble whenever inspection is required.

The units are so designed that the tube element can be pulled straight out from the shell. There is no need to disconnect any tubeside piping.

Misalignment of shell inlet and outlet connections is eliminated because the shell nozzles are integral with the shell. This nozzle-shell piece is accurately machined and identical in all respects. A thoroughly proved metal sealing ring closure is incorporated betweeen the tube and shell, assuring an accurate closure, and is identical with closures used in other Brown units for the past 15 years.

The rear-cover closure is made with six $\frac{3}{4}$-in. alloy studs, easily removed to permit thorough inspection.

Standard 3-in. low-pressure heat exchangers are made with fintubes suitable for design pressures of 5-600 psig. Types are also available for pressures in excess of 5-600 psig, and tubeside-joint designs utilizing a lens ring are furnished for services requiring pressures of 6000 psig and above.

Fintubes for the heat exchangers are available in (but not limited to) carbon steels, stainless steels, nickel, monel, and the chrome-moly alloys. Bulletin No. 110. **—K-38**

Modified Standard Models

"Too custom to catalog, but just right for the job," is the Hydraulic Press Mfg. Co., Div. of Koehring Co., description of modified standard metal-working presses which the company expressly designs for particular applications. Each proposal for a special machine contains complete job recommendations for meeting production problems with maximum efficiency. The company's long experience in hydraulic design reduces to a minimum the amount of engineering required. **—K-39**

Damping Compound

A viscoelastic material which, when sprayed or trowelled onto metal plate, drastically reduces structurally borne noise and vibration has been announced by Korfund Co. The compound renders metal plate acoustically equivalent to a sheet of cork.

Designated Korfund Vibrodamper Compound, this damping material solves the problems of noise transmitted along structural paths through sheet metal, and of the drumming noise created by vibration or thermal movements of metal plates.

A highly effective, economical treatment is thus available for sheet-metal applications such as air ducts, plenums, curtain walls, business machines, computers, transformers, metal doors, pumps, fan scrolls, ship's bulkheads, vibratory feeders, and so forth. It is much more efficient than asphalt felt, bituminous mastics (automotive undercoatings), glass-fiber blankets, and metal tapes.

Where bituminous mastics or single layers of metallic foil provide a vibration decay rate of 3 to 5 db per sec, vibrodamper provides a rate of 35–55 db. It is also 100 times as effective for vibration damping as a $\frac{1}{2}$-in-thick, 6-lb-density glass-fiber blanket. **—K-40**

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Two-Stage Compressors

Compact, preassembled two-stage rotary compressors, specifically designed to simplify installation and foundation problems, constitute a new line announced by Fuller Co.

Featuring an overhead intercooler for greatest possible compactness, the units can be placed for operation in the field either on a floor or mezzanine. All that is necessary at the scene of installation is the addition of motor, air, and water piping.

Two-stage models from C60-60H to C300-300H are included. These cover capacities from 279 to 3300 cfm and discharge pressures to 125 psi. Direct connection can be made to electric motors, gas motors, or gear-turbine drives. Each stage comprises a cylinder with heads, thoroughly water-jacketed. Intake and discharge openings are located in a horizontal plane on opposite sides of the cylinder, avoiding reversal of air flow and further simplifying piping. **—K-41**

Rotary Steppers

Series 18500 identifies a new line of all-magnetic positioning stepper devices introduced by the A. W. Haydon Co.

Designed for precise angular positioning of rotary components such as potentiometers, dials and indicators, the new units may be coupled to synchro transformers or predetermined pulse counters. Series 18500 steppers operate on the number of pulses received, not on changes in phase angle or voltage. Stepping action is achieved magnetically, without ratchets, linkages, or contacts.

When coupled to a synchro transformer, the stepper can be pulsed to rotate through a given number of closed-circuit positions, then, on the last pulse, complete an open circuit aligned with the zero angular reference of the transformer. If the stepper were set with 359 closed-circuit positions and one open, then the 360th pulse would perform a switching function, and at the same time, home the stepper to zero reference.

Harnessed to predetermined pulse counters and corresponding switches, the positioning devices can be used to transmit angular information to remote locations.

Available with characteristics to meet user needs, the devices meet or exceed military requirement MIL-E-5272C. Write for Brochure SP9-I. **—K-42**

KEEP INFORMED

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Dry-Type Transformer

A new line of general-purpose, ventilated, dry-type transformers in ratings 3 through 50 kva, single-phase, 600 volts and below, has been introduced by Allis-Chalmers Mfg. Co.

Designed specifically for indoor use, the new transformers are easy to install because of their smaller size and lighter weight. The three-piece case has convenient knock-out locations to permit standard-size conduit to be connected from either side or bottom.

The core is constructed to give quiet, low-loss, low-exciting-current operation. Coils are wound with high-temperature epoxy-film-insulated wire. Large cooling ducts in the air-flow path assure long life with more than adequate over-load capacity.

The impregnated core and coil unit completely isolated from the case assures quiet operation.

The transformer, shipped completely assembled, is ideal for spot-load-center applications where critical voltage must be maintained for efficient operation of tools, appliances, lighting, and similar applications.
—K-43

Sump and Process Pumps

The addition of two new sizes to the line of Goulds Pumps, Inc., heavy-duty vertical centrifugal sump and process pumps increases the capacity range from approximately 1000 to over 3000 gpm. The new sizes—6 and 8-in-discharge units—are available for pit depths of from 3 to 20 ft for either dry-pit or wet-pit service, and can be furnished in all-iron, bronze-fitted, or stainless-steel construction.

The open impeller used on all units has ejecter vanes on the back side which effectively prevent entrance and jamming of solid materials between the back of the impeller and the stationary side plate. The 6-in. pumps will handle solids up to $1^{11}/_{32}$ in. diam 8-in. pumps up to $2^{27}/_{32}$ in.

For vapor-proof handling of toxic or hazardous liquids all possible points of leakage of vapor or fumes are sealed and an upper stuffing box is supplied which also has a water jacket for cooling. Maximum temperature of liquids handled in standard construction is 200 F. With stuffing box and quench-gland cooling, liquids with temperatures up to 350 F can be handled. —K-44

Dies and Patterns

Pure-nickel forming dies and foundry patterns are produced without machining or other hand work by The Budd Co. Research on the production of better forming dies for the company's own metal-stamping business led to the process which has broad application in metalworking, as well as in the rubber, plastics, and glass industries.

The company's new Carbonyl Metal Products facility is currently manufacturing these nickel dies and patterns for the automotive industry, while continuing research in other fields of application. Only the nickel dies, molds, patterns, and other foundry-equipment items are sold—not the carbonyl process itself.

In the process a gas-deposition technique deposits pure nickel on a eutectic-alloy mold or "negative" of a customer's die, mold, or pattern. The eutectic mold is then destroyed, leaving a pure-nickel shell which is an exact duplicate of the customer's original master. This shell, which may be filled with epoxy resin and metal fibers, and backed with a steel plate, is the end product of the Carbonyl process.

The molding technique duplicates with extreme accuracy. Reproducibility tolerances average ± 0.005, well within the limits established in the foundry industry.

Carbonyl nickel patterns and dies are available in a wide range of dimensions, from about 1×1 up to 60×100 in. There is no limit to the degree of complexity of shape or surface configuration—the more highly complicated the piece, the lower the cost as compared with conventional machining and hand-finishing techniques. The nickel shell can be of any desired thickness. —K-45

Metal Lathe

A "long-bed" Model Delta 10-in. metal-cutting lathe, with a capacity of 36 in. between centers, has been introduced by Rockwell Mfg. Co., Delta Power Tool Div.

The new model also features the variable-speed drive, $^3/_4$-in. collet capacity and all other features of Delta's standard 10-in. metal lathe introduced last year.

Designed to fill the need for a low-cost lathe to do heavy-duty work in commercial metalworking shops, plant-maintenance shops, tool rooms and other industrial operations, the new lathe is compact, modern looking, and easy to operate. —K-46

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BUSINESS NOTES
NEW EQUIPMENT
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Miniature Insulated Thermostat

A $^{1}/_{4}$-in-diam insulated thermostat has recently been added to the Chatham Controls Corp. thermostat line. It is produced with the same patented wiping action as other models and is available with contacts that open or close with temperature rises. Any model can be factory calibrated or externally adjusted to obtain the desired actuating temperature, which is not affected by ambient temperatures.

The bimetal-actuated contact of this thermostat is insulated from the case by means of two glass-seal solder terminals and a ceramic tip pressed into the adjustment screw.

The BW model is recommended for applications requiring the minimum differential consistent with the contact rating. Maximum differential $^{1}/_{2}$ deg C. **—K–47**

LATEST CATALOGS

Plasma Flames

The use of the Plasma jet for research and material-processing techniques is described in Bulletin No. 132 issued by Thermal Dynamics Corp. The apparatus is described, operational theory explained, and uses for materials and aerodynamic testing are given. The Plasma Flame is an electrically heated gas stream, from 500 to 30,000 F, used for materials testing, hyperthermal wind-tunnel studies, controlled-atmosphere welding, heating, melting, chemical synthesis, and other industrial applications. **—K–48**

Dynamometers

Clayton Mfg. Co. turbo-closed system dynamometers are described in a four-page brochure. In these dynamometers the pumping action of the power-absorption unit is used to circulate water through a sealed cooling system and back to the power-absorption unit. They are available for any engine test or run-in requirement. **—K–49**

Meters, Feeders, Controls

"Positive control of materials in motion" is the descriptive slogan of B-I-F Industries, whose Ref. No. 0001.20-1 briefly lists water and waste-treatment systems, butterfly valves, supervisory controls, meters, instrumentation, feeders for solids, liquids, and gases, weighers for solids and liquids, and liquid blenders for that purpose. **—K–50**

KEEP INFORMED

NEW EQUIPMENT
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Ball Valves

A top-entry ball valve designed for use as a sweat-end valve and also available with threaded ends is described in a four-page folder issued by Rockwood Sprinkler Co. Made of bronze, it can be used for oxygen and hazardous liquids as well as water, oil, and gas. Pressure ratings are 300 psi on oil, water, and gas and 400 psi on LPG. Sizes are $^1/_2$, $^3/_4$, 1, and $2^1/_2$ in.

Another Rockwood folder describes leakproof Type 316 stainless-steel ball valves for trouble-free handling of a long list of critical fluids. It is leakproof because two exclusive spring rings automatically back up its two Teflon seats. Temperature range is −120 to +350 F, and it can be easily modified for cryogenics applications. **—K-51**

Motor Controls

Klixon motor controls—inherent overheat protectors, motor-starting relays, motor-winding thermostats, and circuit breakers—made by the Spencer Products Group, Metals and Controls Div., Texas Instruments, Inc., are described in a 60-page catalog. The devices are for electric motors, aircraft motors, pump motors, and such specialized applications as fluorescent ballasts. **—K-52**

Reciprocating Pumps

Complete information on the Aldrich Pump Co. 25 to 2400-hp direct-flow pumps is contained in four-page Data Sheet 100.

Featured are the Aldrich triplex (three plungers), quintuplex (five plungers), septuplex (7 plungers), and the nonuplex (9 plungers) reciprocating pumps. Also described is the Aldrich-Groff Power-Savr pump which features stepless, straight-line control of capacity, from zero to rated output, with no change in speed of power source. **—K-53**

Packaged Steam Generators

Electric input is kept in precise balance with steam output in Speedylectric packaged steam generators designed on a unique electrode principle and described in a six-page bulletin issued by Pantex Mfg. Corp. Various models are designed for 15, 125, 250, 445, and 500 psig to operate on 220, 440, and 550-volt power supplies with capacities up to 1035 lb per hr of steam.

Three electrodes are suspended in a generating chamber within a pressure tank. When electric current is turned on, heat is generated by the resistance of the water to passage of the current between solid metal electrodes. Since the water acts as the resistance element, as the water level drops the electrodes are progressively uncovered and less and less current passes. An assured efficiency of $98^1/_2$ per cent is claimed. **—K-54**

Thread Guide

A basic guide to screw-thread technology—useful to equipment specifiers, engineers and machine designers—has been published by H. M. Harper Co. It briefly outlines the history of threads, defines the terminology, and explains the differences between the major kinds of screw threads.

Several pages of charts detail the measurements, characteristics, and capabilities of the standard thread types according to the Unified and American Thread Series, ASA B 1.1-1960. There are special data on tapping screws and wood screws, and a torque guide for bolts of various metals. Request the "Harper Thread Guide." **—K-55**

Stainless Steel Services

A 12-page bulletin, "Producing Stainless Steels . . . Exclusively," describes how G. O. Carlson, Inc., Department A, "provides a specialized service in manufacturing stainless-steel plate and related stainless-steel products."

Manufacturing procedures are detailed. Applications are illustrated and described. A table shows the standard and superior types of stainless-steel plate—including the precipitation-hardening grades—that are in Carlson's mill inventory or available on order. Basic production limits in manufacturing stainless-steel plates, heads, forgings, rings, circles and flanges, as well as inventory information on bars and sheets (No. 1 Finish), are included. **—K-56**

Steel

The special features of Yoloy E—an exclusive low-alloy, high-tensile steel produced by Youngstown Sheet and Tube Co. are described in a new four-page brochure.

Combining corrosion resistance, high strength, and light weight with easy welding and fabricating, Yoloy E plate and sheet is said to be particularly suited to applications in the marine, transportation, construction-equipment, and office-furniture fields.

Examples of use are given, as is a chart showing fabrication practice for cold forming of Yoloy E. **—K-57**

Miniature Ball Bearings

A four-page, condensed Catalog 2-E-1, describing the miniature ball bearings in the RMB line and issued by Landis & Gyr, Inc., is a brief version of the full RMB catalog. It covers dimensional data, load factors, ball sizes, and weights of sealed and open-radial, flanged-radial, and pivot-type miniature ball bearings. Other leading manufacturers' catalog numbers are listed to give design engineers a ready reference on availability for a specific set of specifications. **—K-58**

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Speed Reducers

Complete information on the Winsmith, Inc., HM series horizontal motorized differential speed reducers is given in Catalog No. HM 60. It contains engineering data, mounting information, service factors, horsepower, torque, and overhung-load ratings for the seven models in the new series, offering a ratio range of 1.1:1 to 50,000:1. **—K-59**

Centrifugal Castings

Centrifugal castings conforming to Military and ASME Code-Approved Specifications, that are used in unfired pressure vessels, radioactive-system service, and other critical applications are described in Bulletin 300 issued by Sandusky Foundry & Machine Co. Data on how the centrifugal castings are made and a number of specific applications are given in the 16-page bulletin. **—K-60**

Thermistors

Fenwal Electronics, Inc., has released a 24-page thermistor manual, EMC-3. Thermistors and their functions are described with several examples of their use, and solutions of thermistor problems. It also includes resistance-temperature tables, and a list of aids that Fenwal Electronics has available to help solve thermistor problems. **—K-61**

Power Piping

Field erection of high-temperature, high-pressure power piping in modern power-generating plants is the topic of a new 12-page brochure published by the Power Piping Div. of the M. W. Kellogg Co.

One section tells how Kellogg manages and staffs its field-erection projects; how detailed plans are developed and executed; and how field-erection costs and quality are controlled.

Another section discusses welding and other important technical aspects of power piping field erection. K-weld, Kellogg's unique gas-shielded arc-welding process, and K-Insert welding are highlighted.

Copies of "Power Piping Field Erection" are available. **—K-62**

Shut-Off Valves

Maxon Series 800 safety shut-off valves are described in an eight-page technical bulletin, No. 8100-60. They are principally used to protect against explosion hazard in connection with standard interlocking safety circuit breakers. The valve immediately shuts off fuel whenever combustion safeguard (or any other switch) breaks the electric safety circuit, and must be reset manually. Maxon Premix Burner Co. **—K-63**

KEEP INFORMED

BUSINESS NOTES
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LATEST CATALOGS

Induction Hardening of Large Gears

"Full Tooth Contour Induction Hardening of Large Gears" is the title of Bulletin 100, offered by the Philadelphia Gear Corp., which fully describes their new method of hardening large gears and the advantages which can be derived from it. **—K–64**

Gate Valves

A four-page circular describing the features and dimensions of the new Union bonnet bronze gate valve, Model 3125, has been published by the Lunkenheimer Co.

Available in sizes $1/4$ to 2 in., Model 3125 has a double wedge disk and rising stem and is rated 125-lb steam pressure—200-lb water, oil, and gas. **—K–65**

Adjustable Drives

GEA-6806, 16 pages, describes new $1/4$–25 hp line of Polydyne mechanical adjustable speed drives introduced by General Electric Co.

The bulletin discusses principles of operation, configurations, and features, and includes mounting positions, rating tables and description of available accessories. **—K–66**

Condensers

Schutte and Koerting Co. lists and describes condensers for condensing steam and removing air and other noncondensable gases, carried in stock, in Bulletin Supplement 5AA-S.

Data are included on: Barometric counter-current condensers, five sizes; low-level eductor condensers, six sizes; and ejector-type concurrent condensers, five sizes. **—K–67**

Steam Traps, Temperature Regulators

The 1960 edition of the Sarco Condensed Catalog issued by Sarco Co., contains 12 pages of technical details, dimensions, and capacity data on the most widely used devices in the complete Sarco line of steam traps, temperature regulators, and heating specialties. **—K–68**

High-Temperature Water Generators

High-temperature-water space and process-heating systems are described in "Babcock & Wilcox, Boiler Div. High Temperature Water Generators."

This 36-page booklet describes varied applications of the two basic high-temperature-water systems designed by B&W to utilize low-cost conventional water-tube steam boilers or forced-circulation boilers.

Request Bulletin G-92. **—K–69**

KEEP INFORMED

NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Check Valves

Streamflow center-guided check valves are described in Miller Valve Co., 12-page Catalog No. 162. Stressing simplicity in design, the Factory Mutual Approved valves have only four parts—a body, seat ring, a specially designed conical spring, and a streamlined center-guided disk. They are available in a variety of materials for 1-in. through 20-in. sizes, and 125 through 2500-lb pressures. **—K–70**

Spreader Stokers

Detroit Rotastokers and Rotograte Stokers are described in Bulletin No. 510 issued by the Detroit Stoker Co. The equipment and techniques for burning a variety of waste and refuse fuels, as well as a wide range of bituminous and lignite coals are described in this 12-page bulletin. Bark, bagasse, spent coffee grounds, wood chips, sawdust, shavings, product trimmings, cocoanut shells, and corn cobs are among the waste and refuse fuels considered. **—K–71**

Forgings

Forged turbine components of a variety of new Superalloys are the topic of a four-page brochure issued by Wyman-Gordon. Waspaloy, René 41, Astroloy, Udimet 500, and M-252 are the alloys in which the company's experience in hot-working permits the guarantee of minimum properties. **—K–72**

Corrosion Control

A data file on corrosion control assembled in a handy folder by Chase & Sons, Inc., is a useful guide to solving pipe corrosion problems. Five products are described with particular emphasis on Chasekote and Chasewrap.

Chasekote is a pressure-sensitive polyethylene tape that provides a tight uniform bond, is chemically inert, resistant to fungus and bacterial action, and has high electrical-insulating properties.

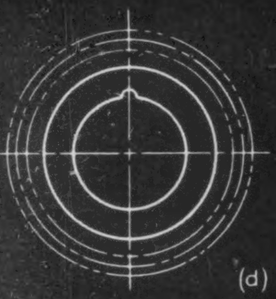
Chasewrap is a tough sheet material available in roll form which adds shielding protection to the Chasekote during backfill and during soil-stress periods. **—K–73**

Bearings and Bars

Standard-stock cast-bronze bearings, cast-bronze bars, powdered-metal plain bearings, flange bearings, thrust bearings, bars, and bearing aluminum bars are covered in Catalog No. 58 issued by the Bunting Brass and Bronze Co. In addition to progressive size and numerical part-number listings with physical properties, there are data on design and engineering, operating principles, oil grooving, and installation. **—K–74**

Quality Control

The equipment and the quality-control techniques utilized in the manufacture of forged-steel valves, fittings, flanges, and unions are illustrated in "In the Hands of Dedicated Men," issued by Henry Vogt Machine Co. The 12-page bulletin features some of the precision testing equipment and the forging, finishing, and inspection techniques employed to control surface roughness, contour uniformity, and load serviceability. **—K–75**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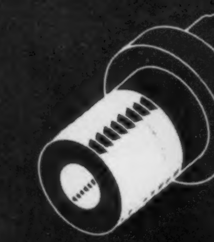
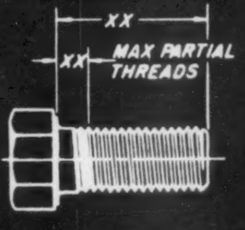
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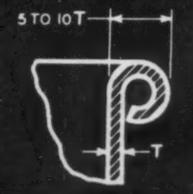
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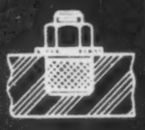
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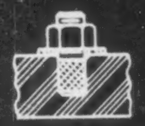
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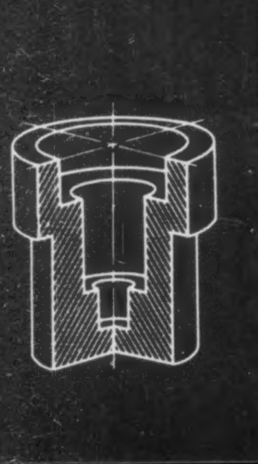
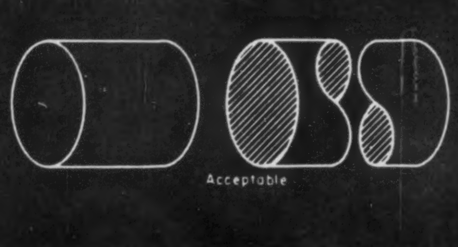
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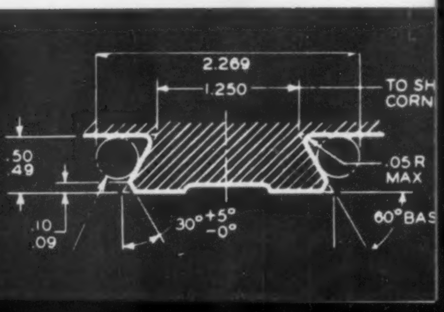
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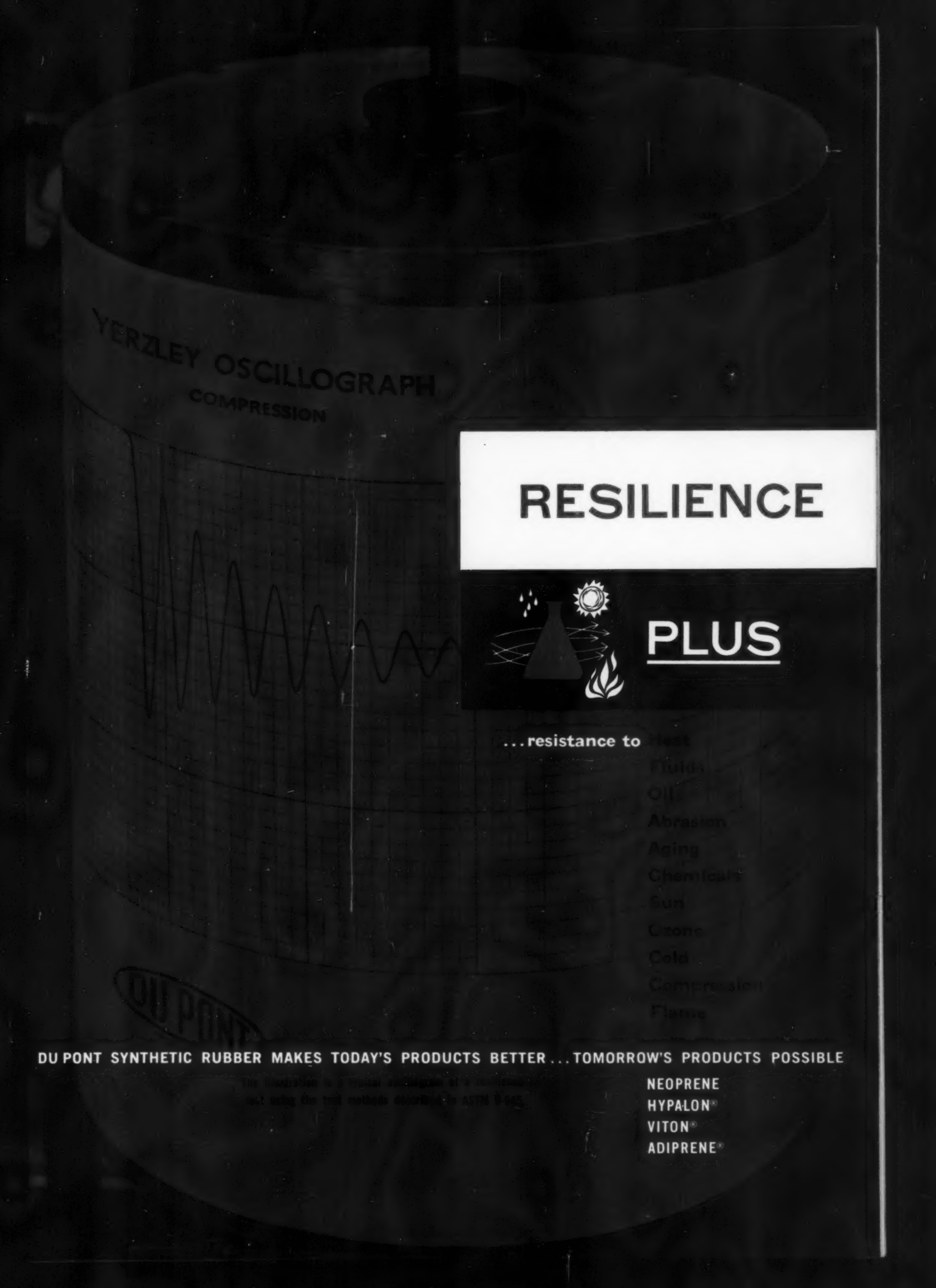
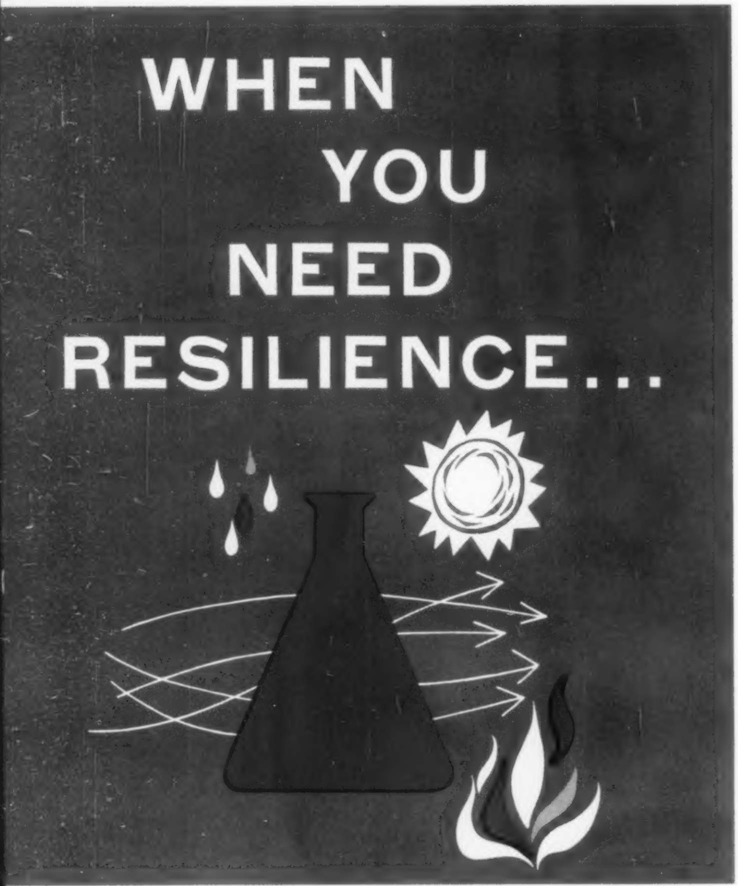

YERZLEY OSCILLOGRAPH
COMPRESSION
RESILIENCE
PLUS
...resistance to Heat
Fluids
Oils
Abrasion
Aging
Chemicals
Sun
Ozone
Cold
Compression
Flame
DU PONT
DU PONT SYNTHETIC RUBBER MAKES TODAY'S PRODUCTS BETTER ... TOMORROW'S PRODUCTS POSSIBLE
NEOPRENE
HYPALON®
VITON®
ADIPRENE®



NEOPRENE

RESILIENCE PLUS A BALANCED COMBINATION OF PROPERTIES

Resistant to heat, flame, chemicals, sunlight, weathering, ozone, oils, grease and abrasion ... proved in performance by over 25 years of successful use in industry.

HYPALON®

RESILIENCE PLUS WEATHER-ABILITY AND COLORABILITY

Color stable ... ozone proof ... resistant to heat, oils, oxidizing chemicals, sunlight and weathering ... excellent for protective paints and fabric coatings.

VITON®

RESILIENCE PLUS RESISTANCE TO HEAT AND FLUIDS

Best of all elastomers in its resistance to corrosive chemicals, fluids and solvents ... performs at temperatures over 400° F.... excellent tensile strength ... low compression set, high modulus ... flame-resistant.

ADIPRENE® L

RESILIENCE PLUS HIGH LOAD-BEARING CAPACITY AND ABRASION RESISTANCE

A liquid polyurethane rubber excellent for casting, potting, molding ... forms a hard, resilient rubber with high load-bearing capacity, unusual abrasion resistance and outstanding low temperature properties.

Coiled heater cord for small appliances is jacketed with neoprene for long-term flexibility, resistance to heat, food chemicals and cooking oils. A test cord underwent 500,000 flexing cycles without damage.

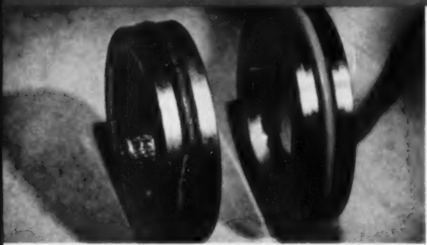
Inflatable dam made from tube of neoprene-coated nylon is used in Los Angeles to divert river water for conservation. Test material withstood weather, sun, abrasion from river debris for two years.

New air valve design for ventilation units is a helical spring covered with neoprene tubing. Neoprene tubing is expected to last as long as the ventilation system and still maintain a tight seal on the close-off.

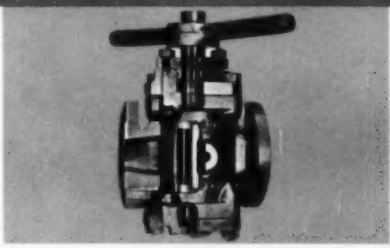
House-size tarpaulin is used by fumigators to keep exterminating gases from escaping. It is made of nylon fabric coated with Du Pont Hypalon . . . resists sun, weather, fumigating gases . . . is easy to handle.

Cathedral roof with sprayed-on coating of Hypalon stays gleaming white in spite of tropical sun, wind, rain and salt spray. Weathering has not caused the reflective roof coating to dull or deteriorate since 1957.

Hypalon shows outstanding resistance to strong oxidizing chemicals. This tubing was used to pump chlorine bleach (5¼% hypochlorite) at 158° F. . . . was still good after a week. Other rubbers failed in 24 hours.

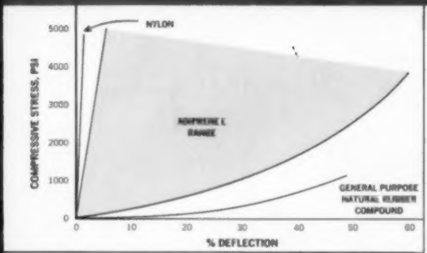


Viton O-rings seal bearings in heat exchanger at 525° F. . . . outlast other synthetic rubbers 25 to 1. They resist fatty acids, dibasic acid, phthalic acid, solvent and petroleum products . . . maintain their resilience.

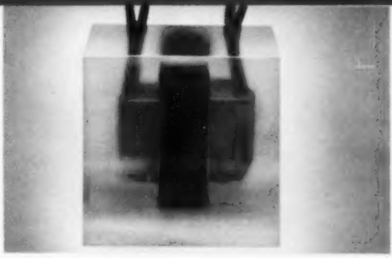


This refinery valve has been used in a benzene line for over a year. Its O-rings and valve seat —made from Viton—are still assuring positive shut-off. Viton parts also resist toluene, xylene, 380° F. alkylate gas, 400° F. propane.

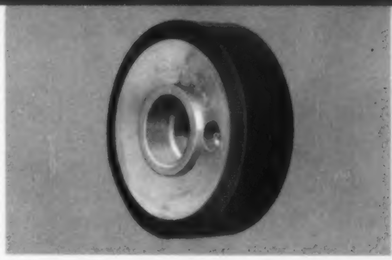
Fire seals in the wings of the new B-58 "Hustler" are made from Viton-coated asbestos fabric . . . resist heat, ozone, jet fuels, fumes and corona . . . are equivalent to stainless steel in fireproofing qualities.



Load-bearing capacity of hard Adiprene L compounds ranges between that of general purpose rubber and the harder plastics. You might use Adiprene L compounds to replace non-elastomeric materials where cushioning or damping properties are needed.



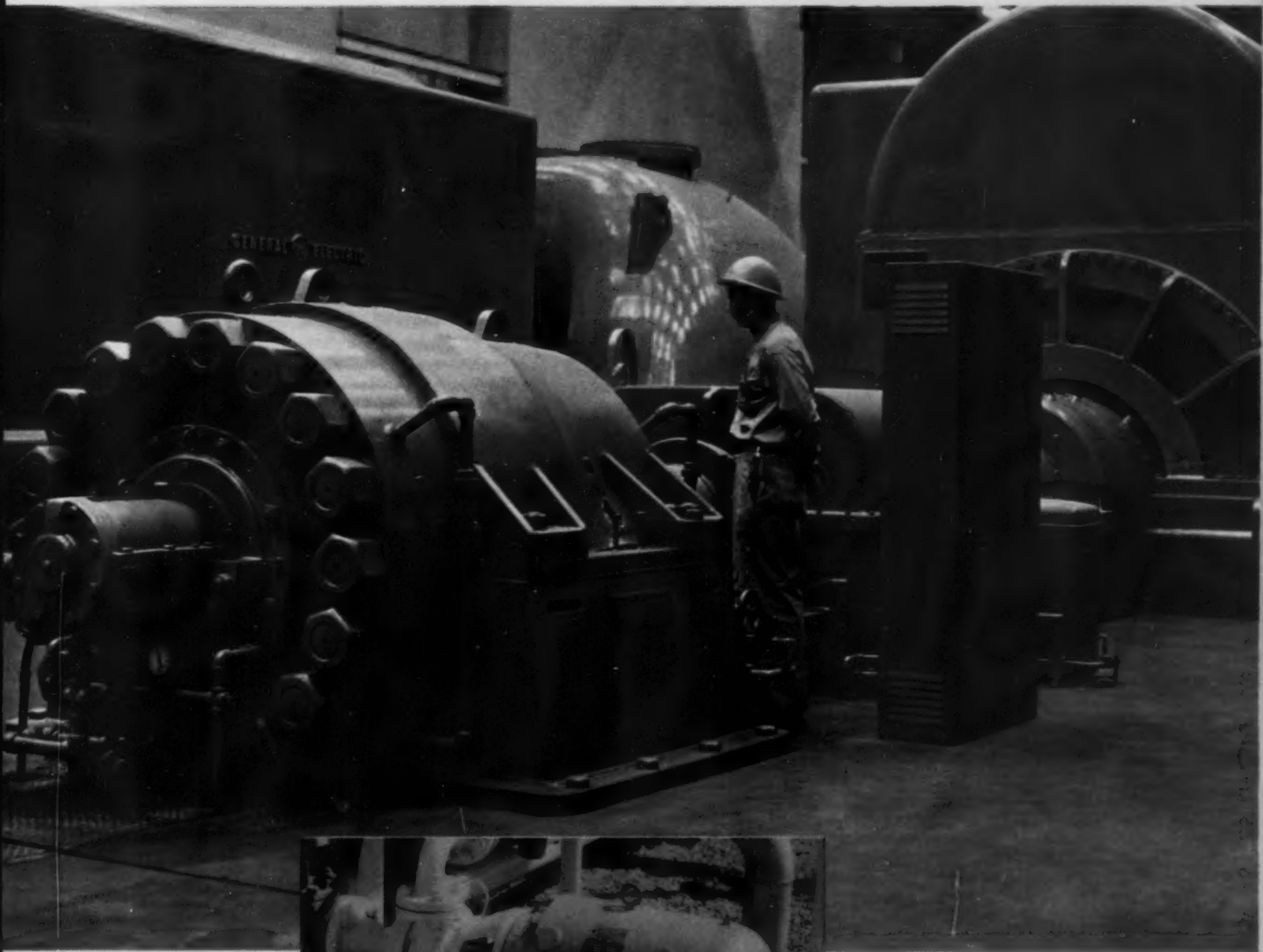
Adiprene L can be used alone or in combination with epoxy resins for potting and encapsulating electrical assemblies. Its flexibility helps protect delicate instruments from damage. It has excellent resistance to thermal shock.



Industrial wheels made of Adiprene L outlast rubber and plastic . . . are outstanding in abrasion resistance. They resist oils, mild acids and alkalies, temperature extremes, weathering and aging . . . are resilient and non-marring.

DU PONT SYNTHETIC RUBBER MAKES TODAY'S PRODUCTS BETTER . . . TOMORROW'S PRODUCTS POSSIBLE

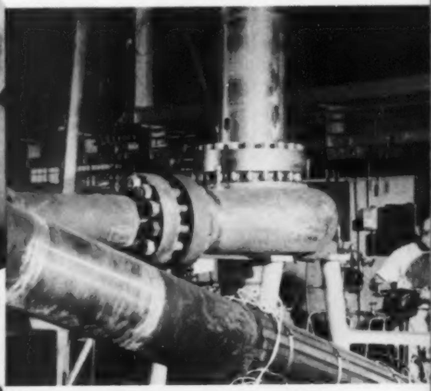

Adiprene L
NEOPRENE JACKETED MISSILE CABLE
an engineering guide to
The Du Pont Elastomers
Viton
SYNTHETIC RUBBER



Quality

HYDRAULIC TESTING puts BJ pumps through their paces before delivery...assures each design will perform as specified. Here, a BJ Vertical Circulating Pump is tested in BJ's newly enlarged test lab, which can handle pumps requiring horsepowers to 12,000, venturi capacities to 70,000 gpm.

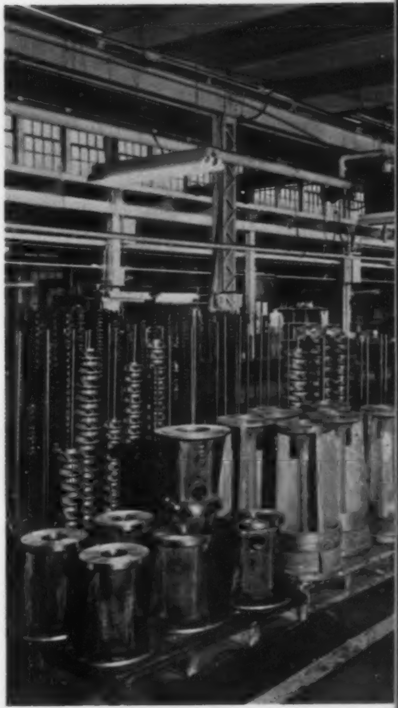
SPECIAL TESTING such as this continuous loop, high temperature test of a BJ Liner-Motor Nuclear Pump can be performed to meet any customer or governmental specifications.



PRECISE ALIGNMENT, here being performed on a special granite slab, is typical of both the special facilities available, and the care and skill of workmanship built into each BJ Pump.

BJ

Here's BJ's program for delivering a quality pump ...on time!



Quality takes time. Time for careful construction techniques, and time for the extra steps necessary to check, test, inspect and examine a quality product.

Byron Jackson works two ways to assure delivery of a quality pump as scheduled.

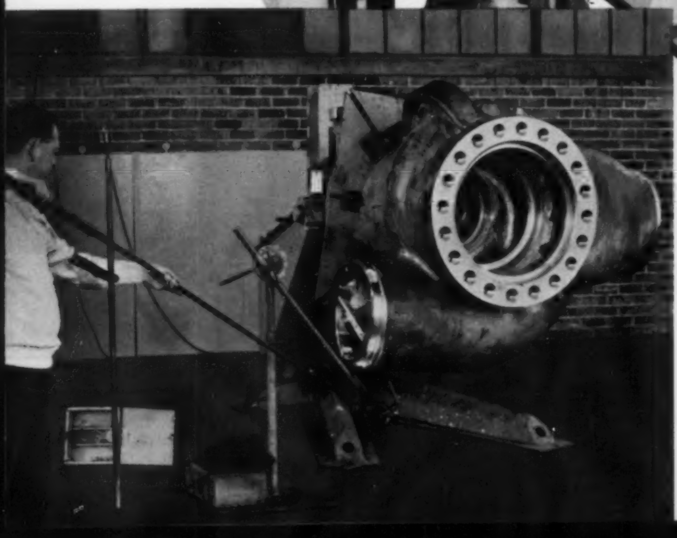
First, on standard type BJ Pumps, adequate inventories of all initial and spare parts are kept at strategic locations throughout the country. Complete pumps or parts can be delivered almost off-the-shelf!

For custom engineered BJ Pumps, an extra large and efficient engineering department is at your command to produce a pump to your specifications —yet with the background of BJ's experience in quality manufacturing since 1872.

After engineering approval, BJ's complete and advanced facilities, some of which are shown here, go to work to build your pump, and to prove its worth through the numerous tests.

Metallurgical control of materials, improvements in processing techniques and non-destructive testing assure a pump built to meet your most exacting specifications.

"CLEAN ROOM" facilities provide cleaning and final assembly of pumps in a completely dust-free atmosphere. It is used primarily for pumps going into nuclear or cryogenic service.



RADIOGRAPHIC INSPECTION of castings, shown here, as well as helium leak testing, dye penetration, ultrasonic and Magnaflux inspections are the type of control procedures used to build the quality in BJ Pumps.

Proved

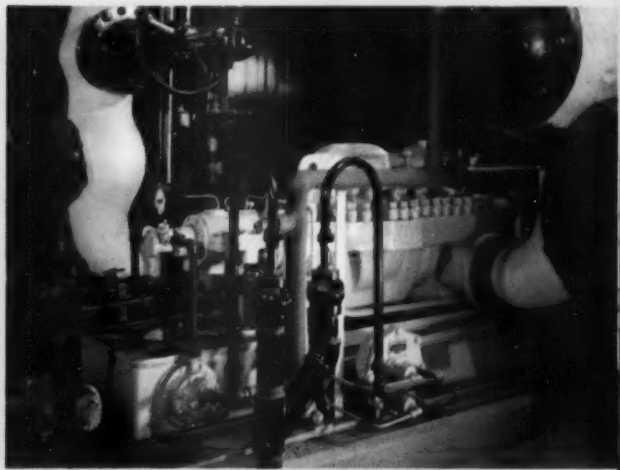
Proved reliable in every application!

The result of BJ's experience in building thousands of pumps for every type of service, is a remarkable record of "World's First's."

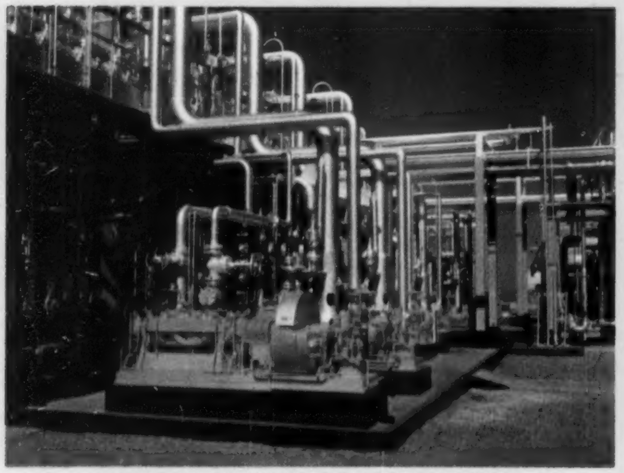
From the first deepwell turbine pump in 1901, to the current World's largest boiler feed and liquid sodium nuclear pumps, BJ has maintained leadership in pump building.

Name your application—BJ can match it with a reliable pump, proved in service, and backed by experience!

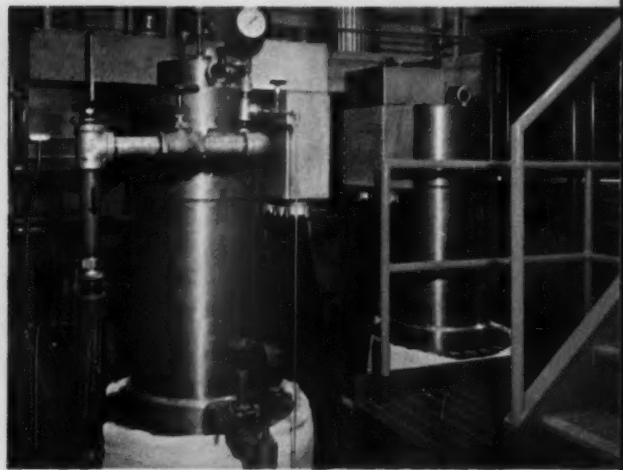
VERTICAL CIRCULATING AND DEEPWELL PUMPS



BOILER FEED, PIPELINE AND HIGH PRESSURE PUMPING



REFINERY, CHEMICAL AND PROCESS PUMPS



NUCLEAR REACTOR, PRIMARY COOLANT PUMPS

Byron Jackson Pumps, Inc.
SUBSIDIARY OF BORG-WARNER CORP.

BJ

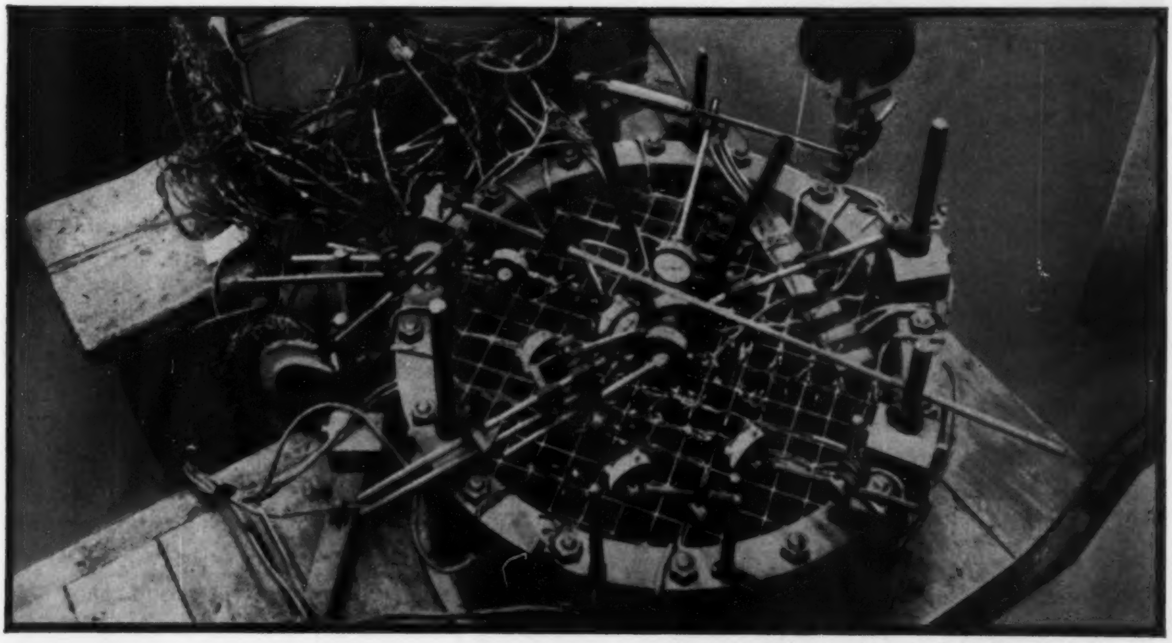
P.O. Box 2017A Terminal Annex
Los Angeles 54, California

Stress Analysts
Investigate

Evaluating the adequacy of grid design when the grid is unevenly heated by gamma rays and subject to hydraulic loads, is basically a problem of determining thermal and mechanical stresses... Maximum stresses are calculated for a solid plate with basic modifications in the equations, such as setting Poisson's ratio to zero and solving compatibility equations between the ring and grid.

GAMMA RAY HEATING

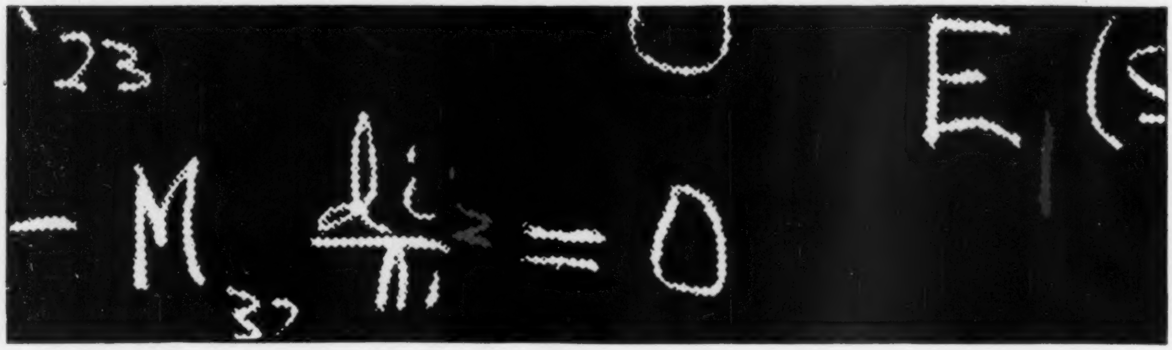
Stress Analysts *— With Masters degree or equivalent experience. Must be able to solve problems in the following: design of nuclear reactor pressure vessels involving stress determinations resulting from internal pressure thermal transients structural discontinuities, gamma ray heating and irradiation damage. If you are a U.S. citizen, write to: Mr. H. D. Altmire, Bettis Atomic Power Laboratory, P.O. Box 1526, Dept. B-68, Pittsburgh 30, Pa.*



Strain Gages shown on ¼ Scale Model of PWR Top Grid

BETTIS ATOMIC POWER LABORATORY

Westinghouse

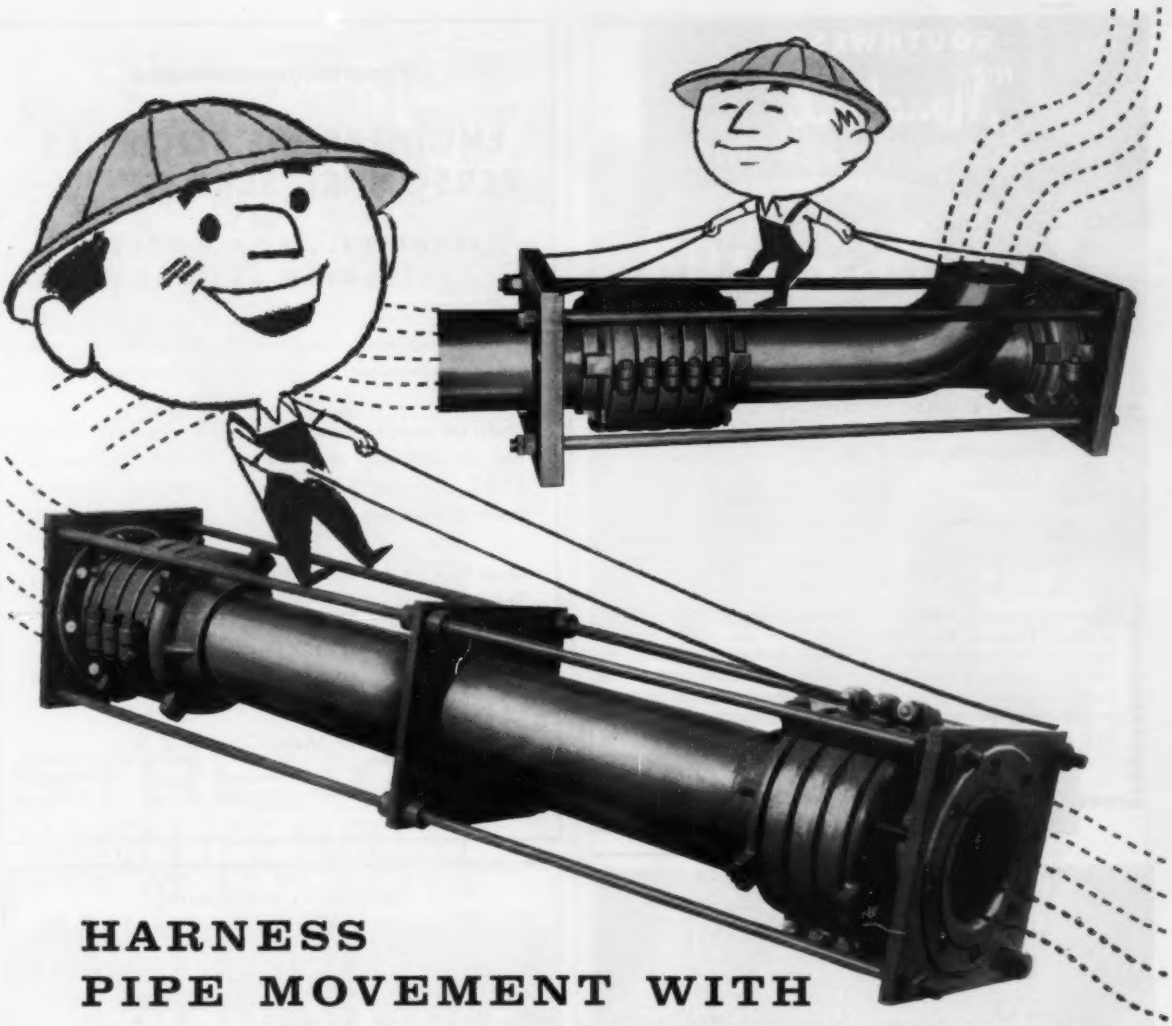


General Motors pledges

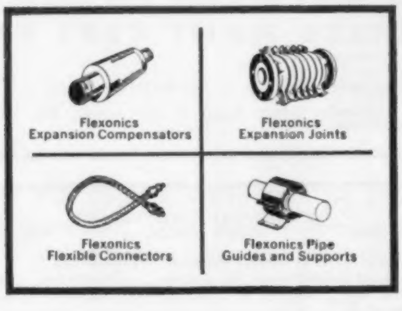
AC QUESTMANSHIP

AC Seeks and Solves the Significant—AC Design and Development is moving far ahead in new technology—the result of GM's commitment to make ever larger contributions to the defense establishment. AC plans to resolve problems even more advanced than AChiever inertial guidance for Titan / This is AC QUESTMANSHIP. It's a scientific quest for the development of significant new components and systems . . . to advance AC's many projects in guidance, navigation, control and detection / Dr. James H. Bell, AC's Director of Navigation and Guidance, sees this as a "creative challenge". His group takes new concepts and designs them into producible hardware having performance, reliability and long life. He strongly supports the fact that an AC future offers scientists and engineers "a great opportunity to progress with a successful and aggressive organization" / If you have a B.S., M.S., or Ph.D. in the electronics, scientific, electrical or mechanical fields, plus related experience, you may qualify for our specially selected staff. If you are a "Seeker and Solver", write the Director of Scientific and Professional Employment, Mr. Robert Allen, Oak Creek Plant, 7929 So. Howell Ave., Milwaukee, Wisconsin.

GUIDANCE / NAVIGATION / CONTROL / DETECTION / AC SPARK PLUG *The Electronics Division of General Motors*



HARNESS PIPE MOVEMENT WITH FLEXONICS EXPANSION JOINTS



Here's how to keep pipe movement under control! **Flexonics Self-Restrained Dual Expansion Joints** can absorb large amounts of lateral movement while keeping anchor forces at a minimum. **Flexonics Pressure Balanced Expansion Joints** replace main anchoring at changes in piping direction, by restraining the end thrust.

These are just two of the standard and special types of expansion joints engineered and built by Flexonics to help you harness pipe movement. **Check and mail the coupon today for complete information.**

Member Expansion Joint Manufacturers Association

EJ-260

Flexonics corporation

In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ont.

EXPANSION JOINTS · METAL HOSE · SYNTHETIC HOSE · BELLOWS · AERO/SPACE COMPONENTS

SUBSIDIARY OF CALUMET & HECLA, INC.

ATTACH TO YOUR LETTERHEAD—MAIL TODAY!

Flexonics Corporation
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Maywood, Illinois

Please rush me complete information on

- ☐ Expansion Joints
- ☐ Expansion Compensators
- ☐ Flexible Connectors
- ☐ Pipe Guides and Supports

MECHANICAL ENGINEERING CARD INDEX

July, 1960 — Vol. 82, No. 7

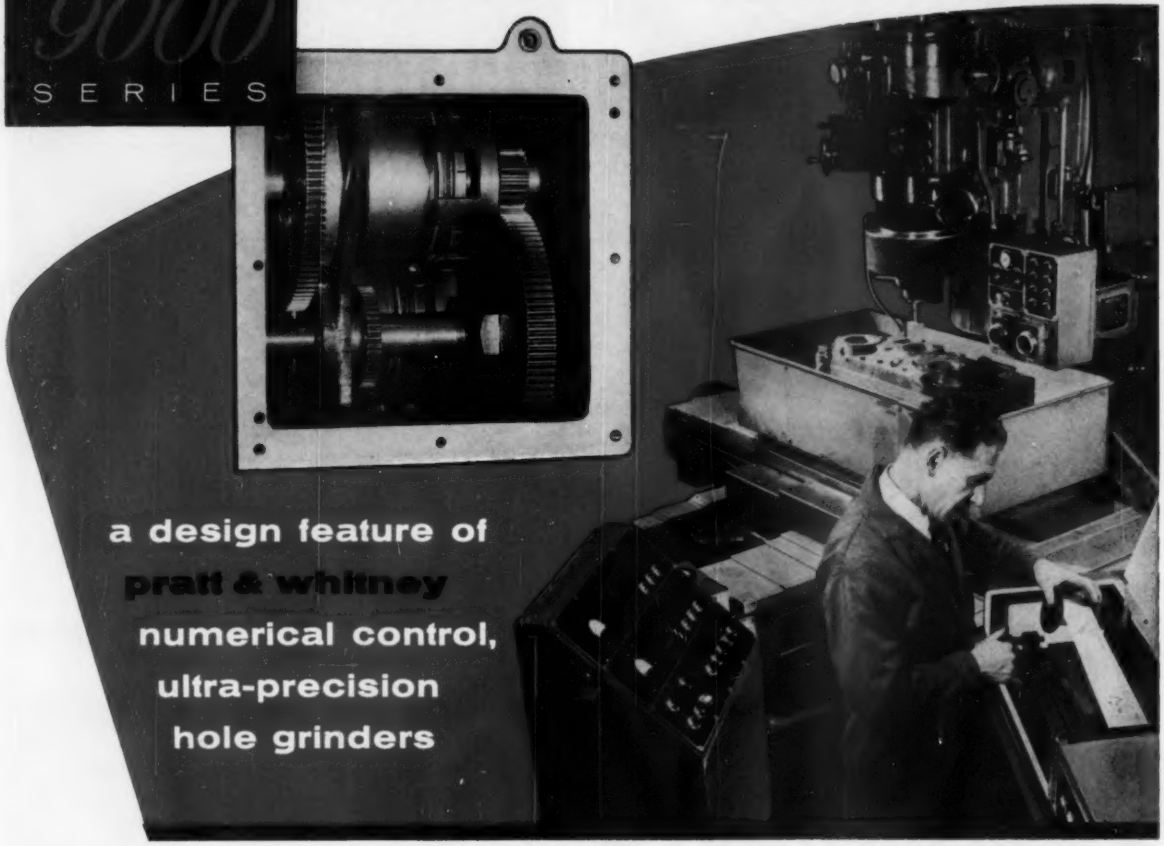
MECHANICAL ENGINEERING CARD INDEX

August, 1960 — Vol. 82, No. 8

Maxitorq

electric clutches and brakes

9000 SERIES



Again a famous machine tool builder favors today's outstanding electric clutches and brakes

Previously, Pratt & Whitney incorporated MAXITORQ Clutches in their high-precision jig borers. Proved performance led their engineers to test and accept the new 9000 series MAXITORQ Electric Clutches for their latest development . . . the fully automatic, numerically controlled, ultra-precision Vertical Hole Grinder and Electrolimit Jig Borers. Inset photograph above shows the compact and "clean" installation of two of these clutches in the carriage control drive gear box.

Incorporating new and advanced design principles, the 9000 Series MAXITORQ Electric Clutch is well adapted to machine tool drives. It is simple in design . . . built to machine tool standards . . . requires no adjustments. It can be used *either as a clutch or brake.* Disc separators not only separate discs but also break up residual magnetism, and result in extremely fast, positive action with no drag or heating in neutral. Design principles have been PROVED through years of service. There are few moving parts. Electrical operating unit remains stationary—hence, there are no troublesome slip rings or brushes; no difficult wiring problems. Clutches operate on standard 110 V a.c. converted to 90 V d.c. Other voltages on special order.

If you have a clutch or brake application where you are looking for NEW and IMPROVED performance, we invite you to bring the problem to us.

Phone, wire or write Dept. ME for new #9000 Series bulletin

M — Let's talk MAXITORQ

The Carlyle Johnson Machine Company, Manchester, Conn.

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instruments, etc. wanted and for sale • representatives • sales agencies • positions open • positions wanted • equipment, material, patents, books, business for sale • partnership • capital • manufacturing facilities

RATES: Classified advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $4.00 a line. $2.00 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display advertisements carried in single column units of multiples of one inch at flat rate of $40.00 per inch per insertion. Copy must reach us not later than the 10th of the month preceding date of publication.

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"OPPORTUNITIES" Section This Month 173-178

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M.E. or Ch.E. — Diversified work — Plant Engineer's staff, large chemical plant. 1-2 years' experience pref'd but not necessary, good benefits. Salary commensurate with experience and ability. Send resume to Industrial Relations, Nitrogen Division, Allied Chemical Corp., Drawer 61, Hopewell, Virginia.

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SALARIED POSITIONS—$6,000 to $35,000. We offer the original personal employment service (established 49 years). Procedure of high standards individualized to your personal requirements. Identity covered. Particulars—R. W. Bixby, Inc., 562 Brisbane Bldg., Buffalo 3, N. Y.

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ENGINEER, registered in Texas, residing in Argentina, offers representation to manufacturers and/or engineering firms interested in petroleum, natural gas, industrial piping, and allied lines. Address CA-6983, care of "Mechanical Engineering."

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to work out solutions

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***** **The asterisk indicates that firm has product catalog in the 1960 Mechanical Catalog.**

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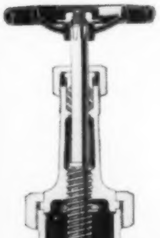
No other 125 lb. Union Bonnet Bronze Gate Valve has all these features

Union Bonnet for extra safety . . . *cylindrical* body design to distribute pressure uniformly and prevent distortion . . . *extra thickness* at points of greatest strain . . . these features *alone* provide the vital margin of superiority over other valves in its class. Together with Stemalloy Stems®, Non-Slip® Handwheels, and many other exclusive features, they actually put this outstanding new valve in a class by itself. You will *see why* when you compare it part-for-part with any other valve designed for similar service. Let your Lunkenheimer Distributor make this comparison for you, or write the Lunkenheimer Company, Cincinnati 14, Ohio.



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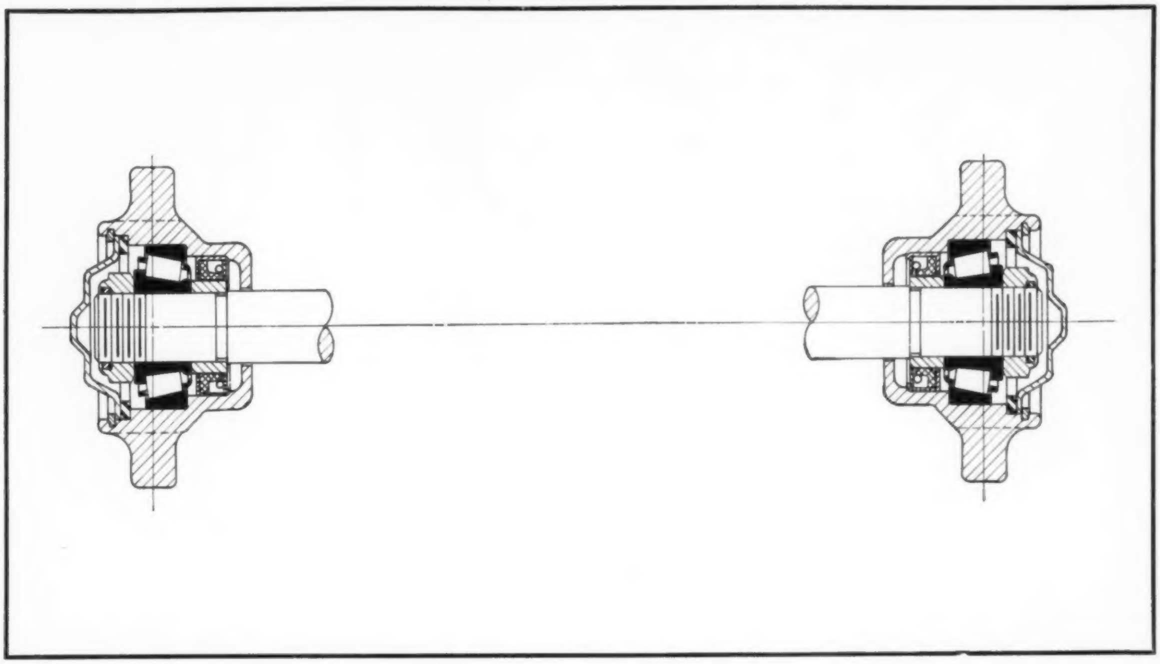
THE ONE *Great* NAME IN VALVES

L-360-85

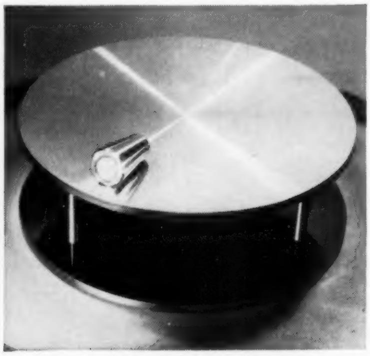
HOW JOY MOUNTS IDLERS TO FIGHT WEAR FROM DIRT AND DUST



By designing their Limberoller® two-bearing, single-unit catenary idlers to use Timken® single-row tapered roller bearings (see above), Joy Manufacturing engineers reduce bearing failures caused by dirt, dust, moisture . . . assure spillage-free conveying and trouble-free idler performance. Timken bearings hold the idlers on center at all times, increase sealing efficiency. Idlers roll easily under heaviest loads, belt moves smoothly.

On these applications, Timken bearings assure minimum maintenance, long bearing life because: 1) They hold shafts concentric with housings, making closures more effective in keeping lubricant *in*, dirt *out*. 2) The tapered construction of Timken bearings lets them take radial and thrust loads in any combination.

ENGINEERING SERVICE FOR THE ASKING. Let our Timken bearing salesmen—graduate engineers—tackle your bearing problems, solve them in a hurry. Save *you*—time and money.



ROLLS FOREVER IN PERFECT CIRCLE on oscillating table, proving the accuracy of its taper. Another demonstration of Timken bearings' precision manufacture that assures trouble-free performance.

Industry rolls on

TIMKEN®

tapered roller bearings

The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO." *Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.* Canadian Division: Canadian Timken, St. Thomas, Ont.

Call on us at the Production Engineering Show, Chicago Navy Pier, September 6-16, Booths 314, 316.